

**TWIN DISC
INCORPORATED**



Service Manual

Marine Control Drive

Components:
MCD 3000

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Marine Control Drive Service Manual



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 3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.
 4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
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 6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or are Twin Disc authorized replacement parts, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.
- C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer's and subsequent purchaser's employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.
- D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.
- E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.
- F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

*Note The Above constitutes the basic Twin Disc, Incorporated General Limited Warranty and may be supplemented by additional published warranty terms dependent upon the product involved. Supplementary warranty terms are available upon request.

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Introduction

General Information

This publication provides service information for the Twin Disc model MCD 3000 Marine Control Drive. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA.

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unacceptable maintenance/working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

WARNING

Selecting **NEUTRAL** disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Ordering Parts and Obtaining Services

WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts using the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, resulting from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [<http://www.twindisc.com>]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department, Twin Disc, Incorporated, Racine, Wisconsin 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

The Marine Control Drive (MCD) is a variable speed drive available in a range of sizes and power capacities. Power is transmitted by a modulated clutch mounted in a housing that serves as a support and an oil sump.

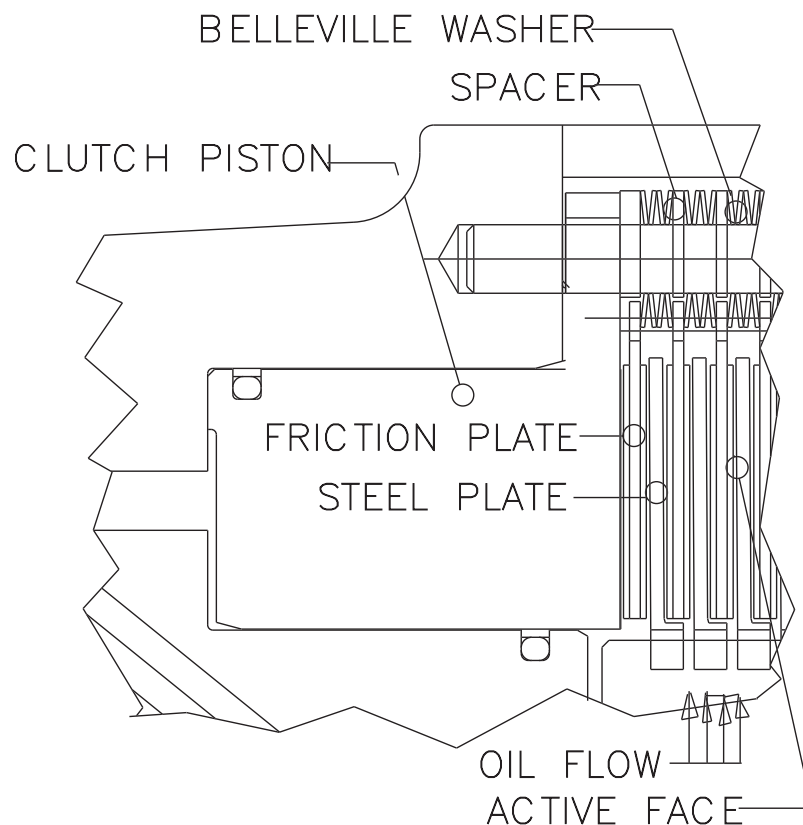


Figure 1. Clutch

The clutch comprises a stack of plates, which are free to move axially. They are fixed alternately to the driving and driven shafts constituting a type of multi-plate clutch.

The number of plates is determined by the power to be transmitted. Steel plates are connected to the output shaft; and steel cored friction plates are connected to the input shaft. Friction plates are grooved to allow oil to flow continuously between them.

Hydraulic Circuit

The prime mover (diesel engine or electric motor) drives two pumps through input driven PTOs. The smaller pump provides a basic main pressure for the MCD control. The larger pump develops the oil flow for lubrication. Both oil flows are drawn from the oil sump through a suction strainer with a metallic screen, which can be removed and cleaned without the need to completely drain the sump.

MCD Hydraulic Control

The oil flow for the control is additionally filtered at 10 μ nominal and 25 μ absolute. The oil filter element cannot be cleaned, but must be replaced when the clogging indicator is showing (clogged filter message is shown on electronic controller display). A safety valve in the filter head allows the oil to by-pass the filter element when clogged. This is to avoid bursting the filter element.

The main pressure regulating valve is factory adjusted in relation with application requirements.

A manual valve in series with the servo-valve provides a manual safety engagement of the MCD in case of electric or electronic failure. During normal operation, this valve must stay in fully open position.

An electrical signal from the electronic control system energizes a proportional servo-valve (Fema Valve) that provides a pressurized oil supply to engage the clutch. Precise output speed is controlled by a governor valve (omega valve) that is located near the outer diameter of the clutch. More electrical current will result in higher output speed.

MCD Lubrication Circuit

The main oil flow is directed between the clutch plates with a small amount by-passed for bearings and gear lubrication. At the clutch outlet, this flow is maintained under a factory adjusted lube pressure between 2.5 Bar and 3.5 Bar (35 psi and 50 psi) to insure a good lube distribution as well as a reasonable back pressure to the clutch piston to insure a proper clutch release when omega valve is closed. After that, the oil flow is directed to an oil water cooler. The cooler is by-passed via a thermostatic valve while oil temperature is too low.

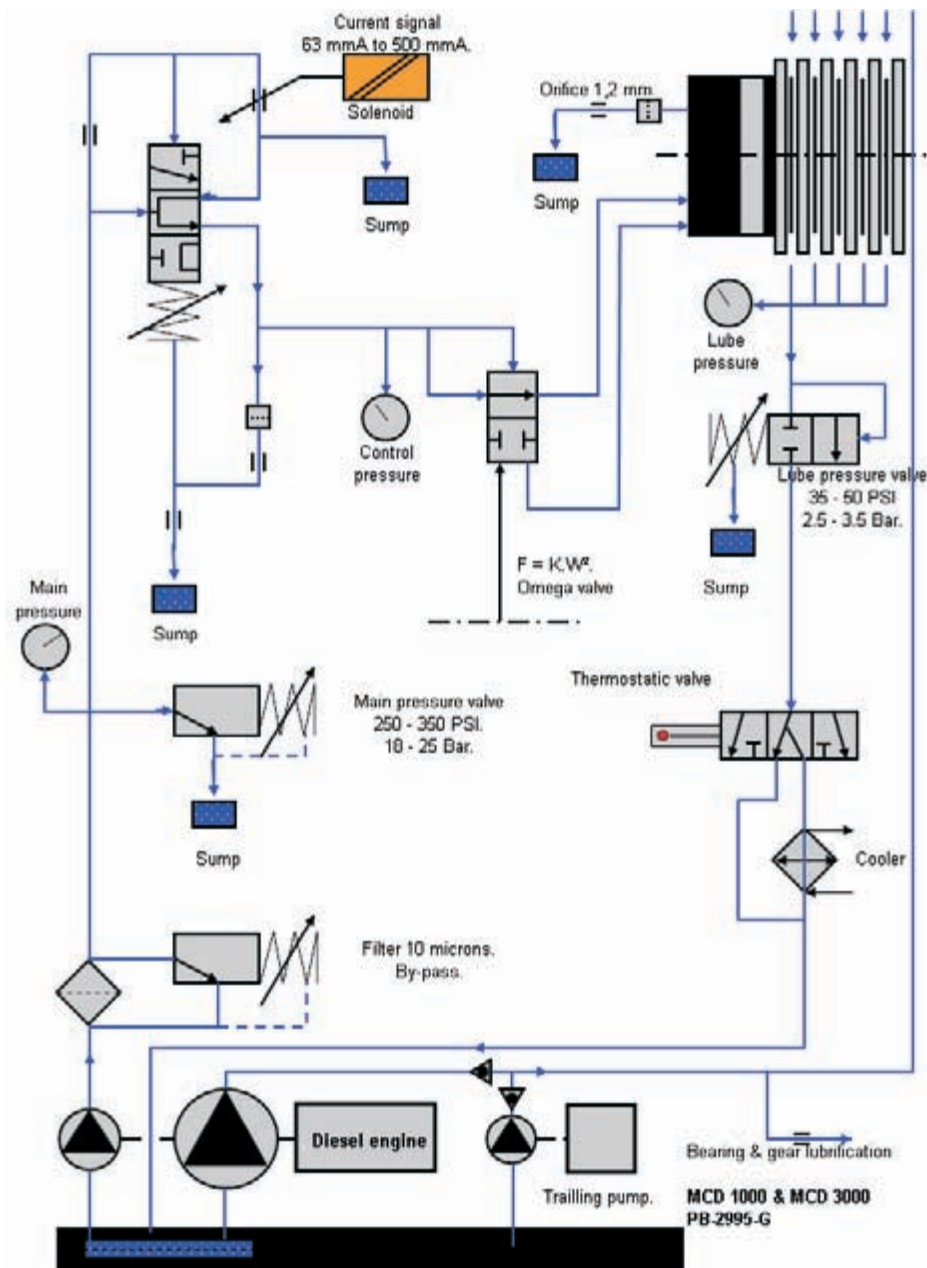


Figure 2. Hydraulic Circuit

The Electronic Controller

General

The main function of the electronic controller is to control the MCD output speed.

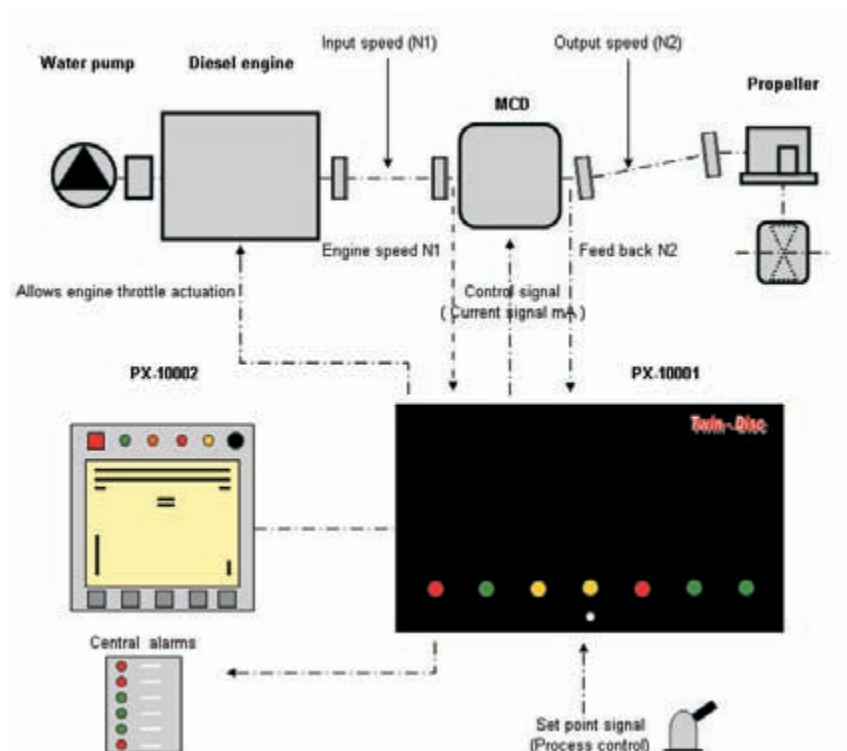


Figure 3. Electronic Controller

The set point signal (Speed demand) may be provided in two different ways according to the application requirements.

- Through a joystick equipped with a potentiometer (local mode) providing the controller with a DC voltage signal.
- Through an external voltage or current source (remote mode), which can be provided, for instance, by a computer.

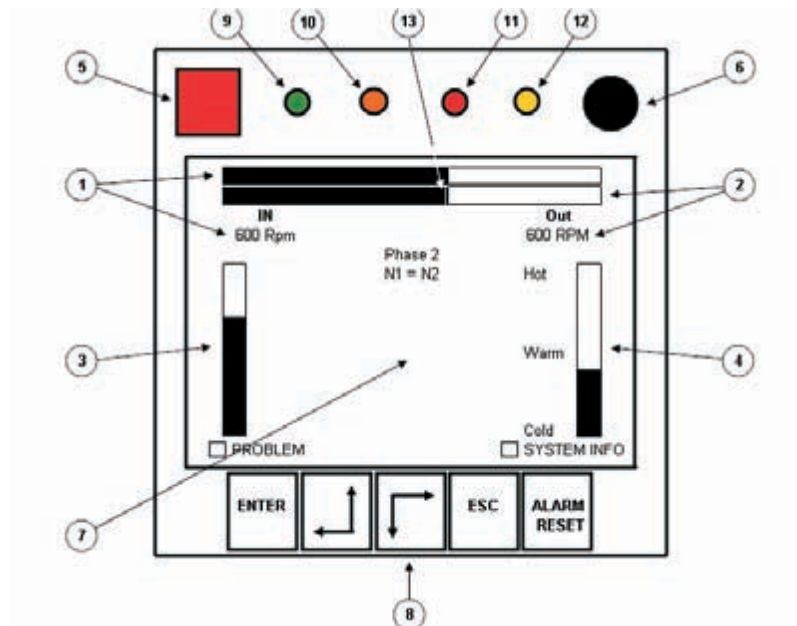
In both cases the setpoint signal is digitalized and injected into the Microprocessor P/N PX-10001, which is permanently comparing the setpoint signals and the feedback signals (from a 'DC converter'). If any difference between both signals is detected, the microprocessor will minimize this difference by increasing or decreasing the control current to the MCD servo-valve, controlling the output speed.

Real Time Data

The microprocessor display provides the user with a wide range of operating information:

On the main screen.

- Engine speed.
- MCD set point signal.
- MCD feedback signal.
- Oil temperature.
- Control pressure.
- Warnings and faults.



Legend:

- 1 Bar graph and data indicating the Input speed
- 2 Bar graph and data indicating the feedback signal
- 3 Bar graph indicating the Control pressure
- 4 Bar graph indicating the lube oil temperature
- 5 Emergency switch
- 6 The contrast knob
- 7 Area listing the MCD problem
- 8 The control keys
- 9 Spot light indicating MCD fully engaged
- 10 Spot light indicating MCD fully opened
- 11 Spot light alarm indicating MCD fault
- 12 Spot light FIFI mode
- 13 Set point signal

Figure 4. Display

Alarm Control

The electronic controller provides two different types of safety messages: **Warnings and Faults.**

Warnings inform the user, via the display, of potential problems affecting the MCD. After a preset time delay (time-outs), if the problem is still persistent, the warning will become a fault.

In any case, a message is displayed, which shows whether the problem is a warning or a fault and it is possible to go through more details by selecting the “PROBLEM” section in main menu. The following tabulation is a list of all possible faults that can occur during the operation of the MCD. In some cases, the fault will shut down the MCD.

Action	Message on Display	Description
Warning	WARNING - OIL LEVEL LOW	Oil level below preset value
Warning	FAULT CONDTN - OIL TOO HOT	Oil temperature too hot
Warning	WARNING - FILTER CLOGGED	Oil filter clogged - switch is open
Warning	ALERT CONDTN - MAIN PRESS LOW	Main pressure too much below preset value
Fault	FAULT SHUT DOWN - CLUTCH SLIP	Slipping in lock-up phase
Fault	FAULT CONDT - IP or OP TACH LOST	Lost input or output speed signal
Fault	FLT SHUT DOWN - IP SPEED TOO HI	Engine speed too high
Fault	FAULT - IP SPEED TOO LOW	Idle speed too low
Fault	ALERT CONDTN - JOYSTICK INTEGRITY	Joystick lever line open (lost)
Fault	ALERT CONDTN - REM. INTEGRITY	Remote lever line open (lost)
Fault	FLT SHUT DOWN - LUBE TOO LOW	Lube pressure too much below preset value
Fault	VOLTAGE LOW	Power supply below 19 vdc

Example:

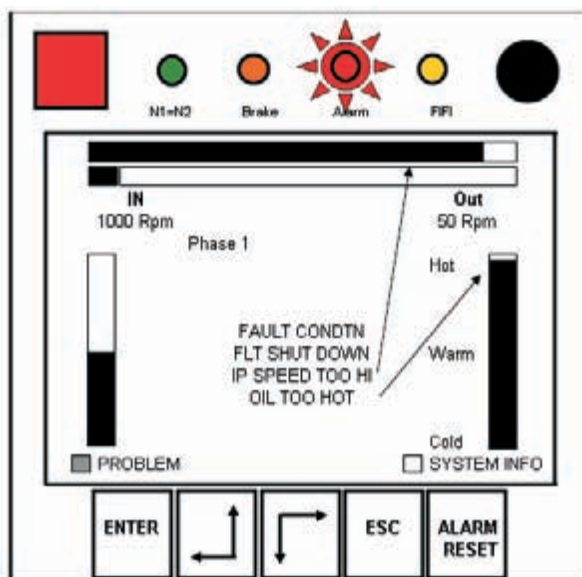


Figure 5. Message Display

Specifications

Power Range

Light Duty:	3800 kW (5096 HP) @ 1500 RPM
Heavy Duty:	1500 kW (2011 HP) @ 1500 RPM

Input Drive

Tapered shaft with optional flanges

Output

Tapered shaft with optional flanges

Weight

2300 Kg (5071 Lbs.)

Oil capacity

(90 to 310 liters (23.8 to 81.9 U.S. gallons) depending on the model)

MCD 3000-1 through MCD 3000-6:	100 liters (26.4 U.S. gallons)
MCD 3000-7 through MCD 3000-9:	300 liters (79.3 U.S. gallons)

Alarms

Several alarm functions that monitor operating conditions can be provided as desired.

Sensors

Several optional sensors are available for use with the MCD

Drag Curves v. Input Speed - Typical (Clutch Disengaged)

Note: Drag torque is related to the number of plates. Data shown here is for a specific application, and is presented only to demonstrate oil temperature effect.)

Mechanical losses : Clutch fully engaged.
38 Kw at 1000 Rpm .

Legend: — 5 JB 139

Clutch fully disengaged.
38 Kw at 1000 Rpm .

----- 5 JB 140

Residual torque : Min @ 400 Rpm : 75 N.m at 75°C.
360 N.m at 25°C .
Max @ 1000 Rpm : 240 N.m at 75°C .
765 N.m at 25°C .

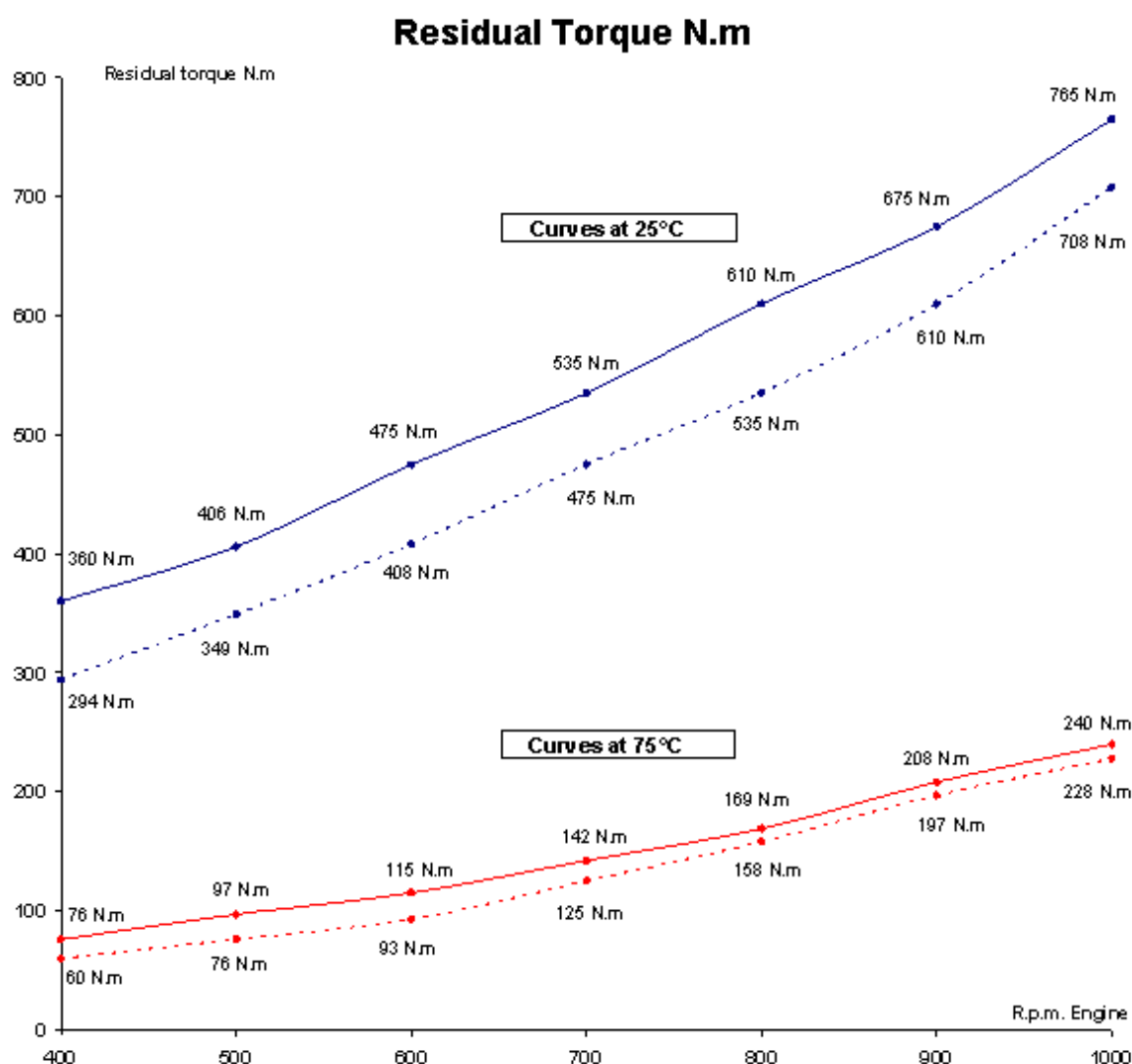
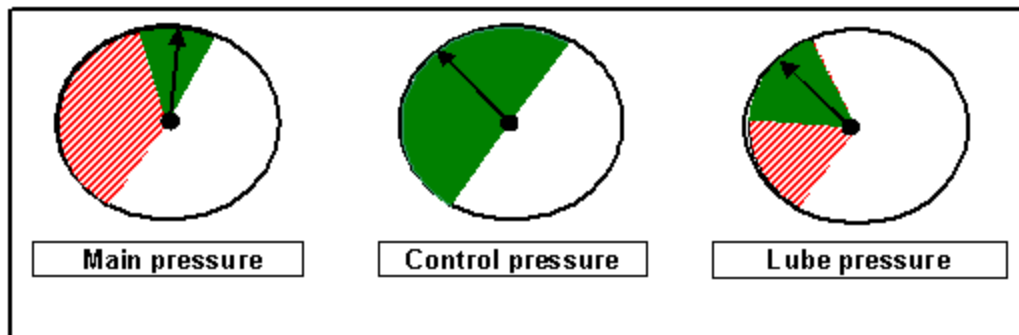


Figure 6. Residual Torque v. Oil Temperature

Normal Working Pressures Range



Main pressure range ----- 18 Bar to 25 Bar (Idle speed to full speed).
Control pressure range ----- 1.5 bar to maximum main pressure setting.
Lube pressure ----- 2.5 bar to 3.5 Bar (Idle speed to full speed).

Figure 7. Normal Working Pressures

Oil Pressure (Typical)

Note: Data in the following charts are indicative, and are average values. They can fluctuate during the life of the unit without being detrimental to its performance or life.

Note: Refer to the A.U.T. alarm pressure adjusting tables for minimum and maximum settings, if available.

Input speed of prime mover: 400 RPM						
CLUTCH FULLY ENGAGED: N1 = N2 = 400 RPM						
Sump oil temperature (room and service)	77°F (25°C)			167°F(75°C)		
	kPa	PSI	Bar	kPa	PSI	Bar
Main Pressure	2100	305	21.0	1800	261	18.0
Control Pressure	2050	297	20.5	1750	254	17.5
Lube Pressure	280	40.6	2.8	280	40.6	2.8
Current in Servo-valve to obtain max. Control Pressure	420 mA			450 mA		

Input speed of prime mover: 400 RPM						
CLUTCH FULLY DISENGAGED: N1 = 400 RPM; N2 = 0 RPM						
Sump oil temperature (room and service)	77°F (25°C)			167°F(75°C)		
	kPa	PSI	Bar	kPa	PSI	Bar
Main Pressure	2150	312	21.5	2100	305	21.0
Control Pressure	100	14.5	1.0	100	14.5	1.0
Lube Pressure	300	43.5	3.0	300	43.5	3.0
Current in Servo-valve to obtain min. Control Pressure	63 mA			63 mA		

Input speed of prime mover: 1000 RPM						
CLUTCH FULLY ENGAGED: N1 = N2 = 1000 RPM						
Sump oil temperature (room and service)	77°F (25°C)			167°F(75°C)		
	kPa	PSI	Bar	kPa	PSI	Bar
Main Pressure	2200	319	22.0	2200	319	22.0
Control Pressure	2200	319	22.0	2150	312	21.5
Lube Pressure	480	69.6	4.8	420	60.9	4.2
Current in Servo-valve to obtain max. Control Pressure	460 mA			500 mA		

Input speed of prime mover: 1000 RPM						
CLUTCH FULLY DISENGAGED: N1 = 1000 RPM; N2 = 0 RPM						
Sump oil temperature (room and service)	77°F (25°C)			167°F(75°C)		
	kPa	PSI	Bar	kPa	PSI	Bar
Main Pressure	2250	326	22.5	2200	319	22.0
Control Pressure	100	14.5	1.0	100	14.5	1.0
Lube Pressure	520	75.4	5.2	480	69.6	4.8
Current in Servo-valve to obtain min. Control Pressure	63 mA			63 mA		

Adjusting A.U.T. Alarm Pressure (optional)

Main Pressure -- Adjustment of Main Pressure Switch - M.P.L.			
	kPa	PSI	Bar
Main Rod			
Differential Rod			
Switch to open at decrease of pressure			

Main Pressure -- Adjustment of Main Pressure Switch - M.P.L.			
	kPa	PSI	Bar
Main Rod			
Differential Rod			
Switch to open at decrease of pressure			

Lubrication Pressure -- Adjustment of Lubrication Pressure Switch - T.L.L.P			
	kPa	PSI	Bar
Main Rod	190	27.6	1.9
Differential Rod	80	11.6	0.8
Switch to close at decrease of pressure	110	15.6	1.1

Main Pressure -- Adjustment of Main Pressure Switch - M.P.L		
	°F	°C
Main Rod	210	99
Differential Rod	70	21
Switch to close at decrease of temperature.	172	78

Normal Working Temperatures

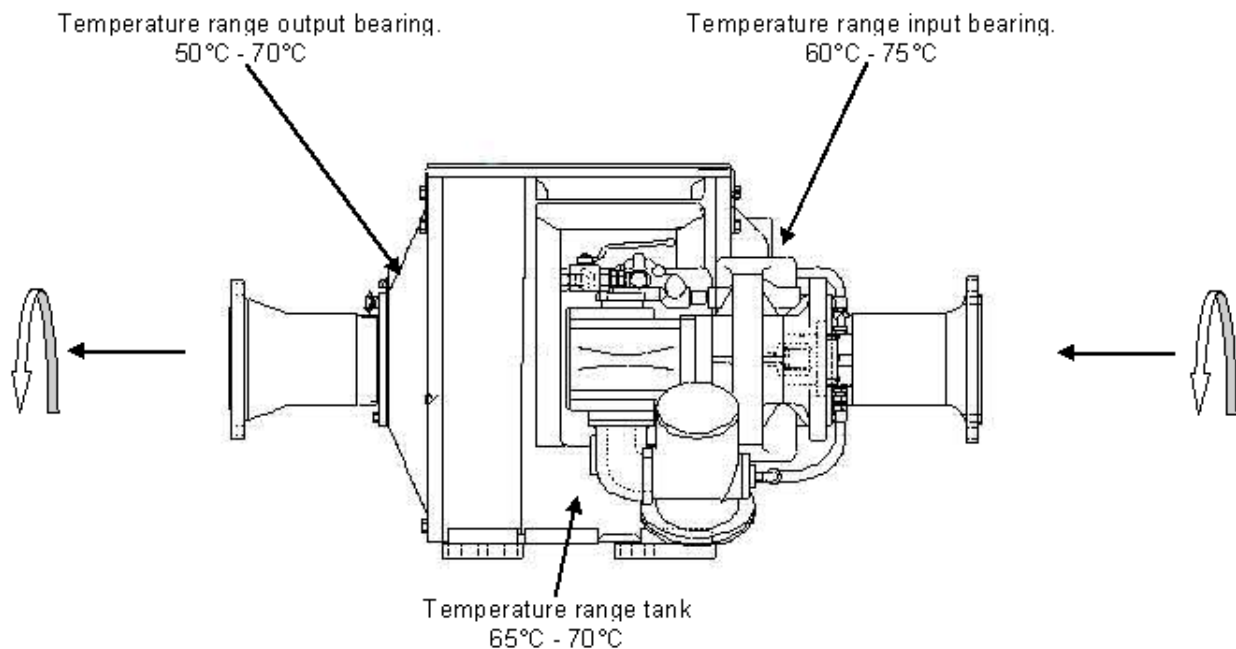


Figure 8. Normal Working Temperatures

Cooling System

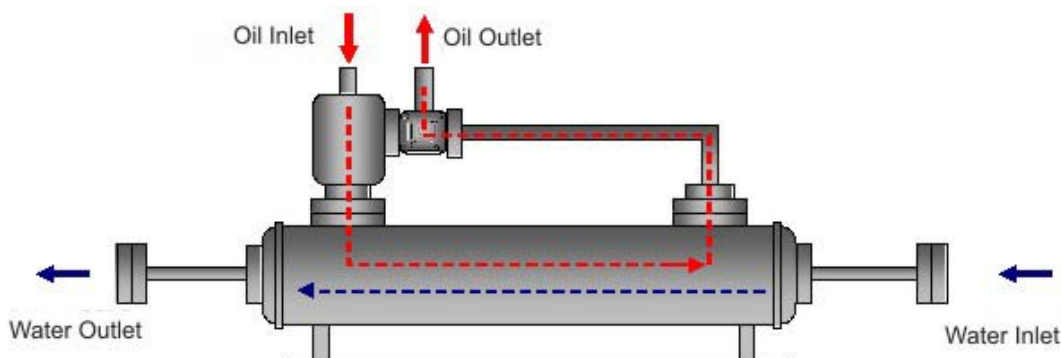


Figure 9. Cooling System

Tube type for remote mounting
 Max water temperature: 35°C (95°F)
 Max water pressure: 72.5 PSI (5 Bar)

Heat Exchanger Requirements

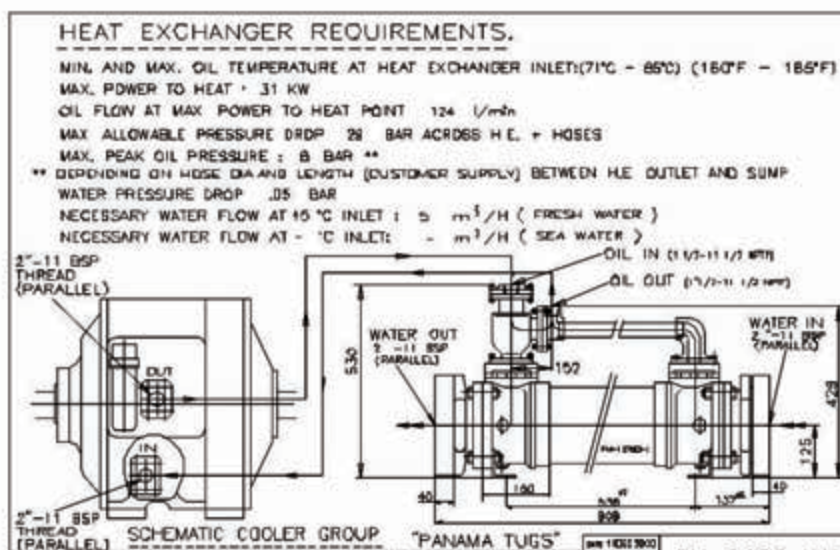


Figure 10. Heat Exchanger

Pressure Adjustments

General

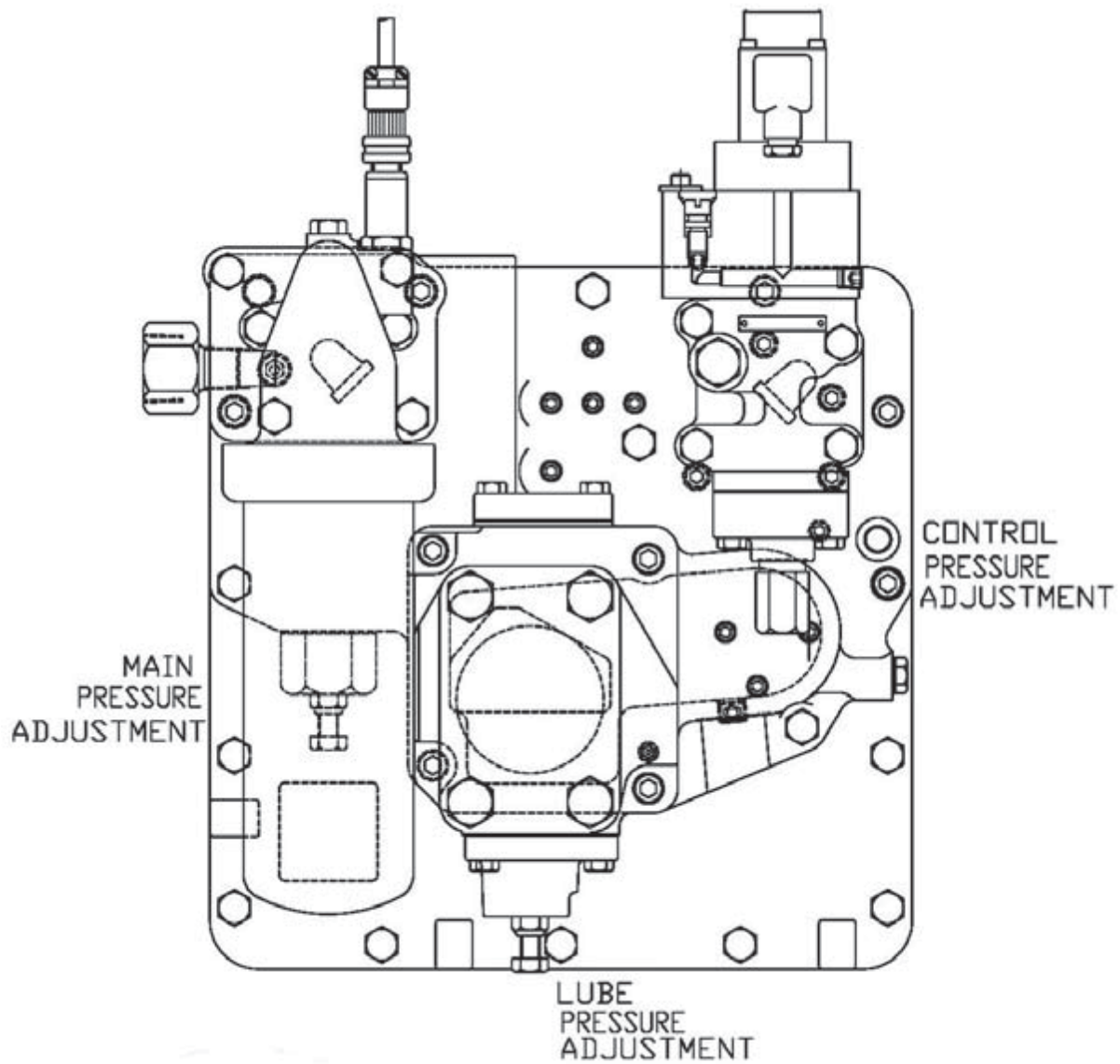


Figure 11. Valve Arrangement

Main Pressure Valve

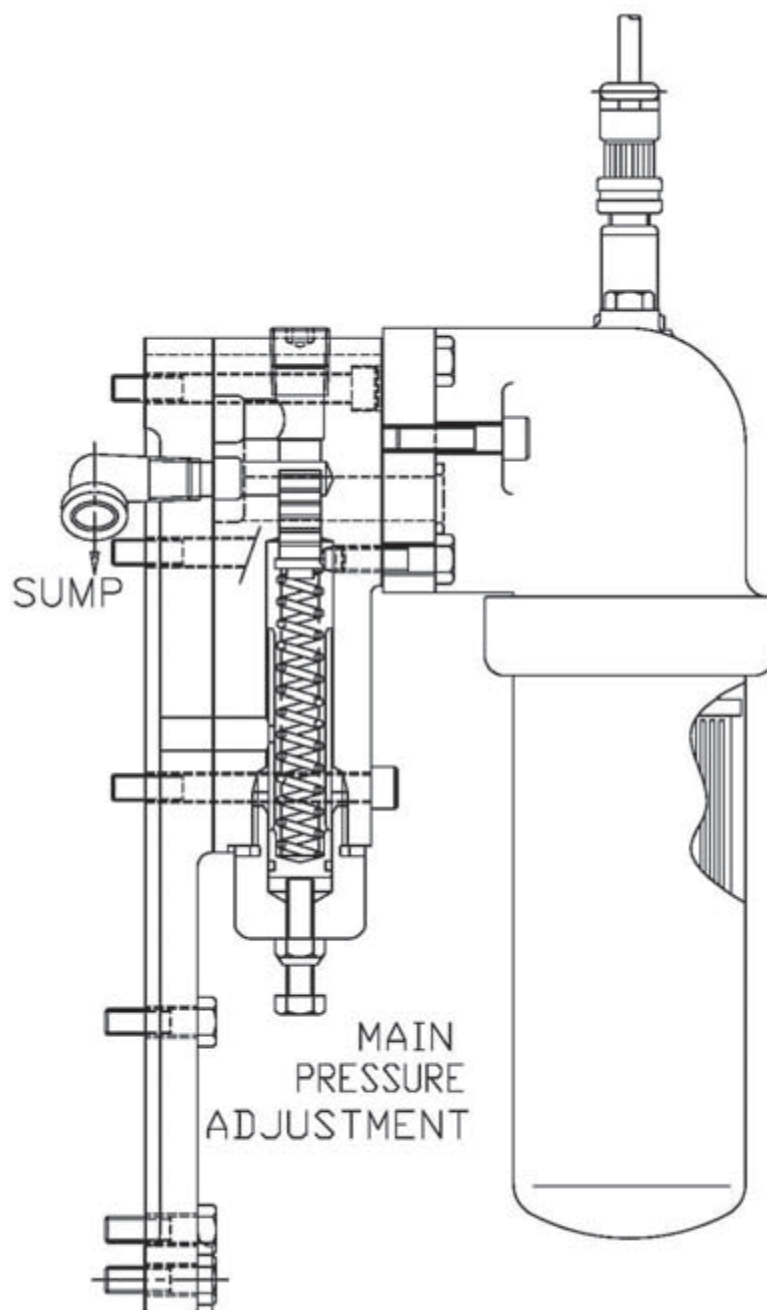


Figure 12. Main Pressure Valve

Lube Pressure Valve

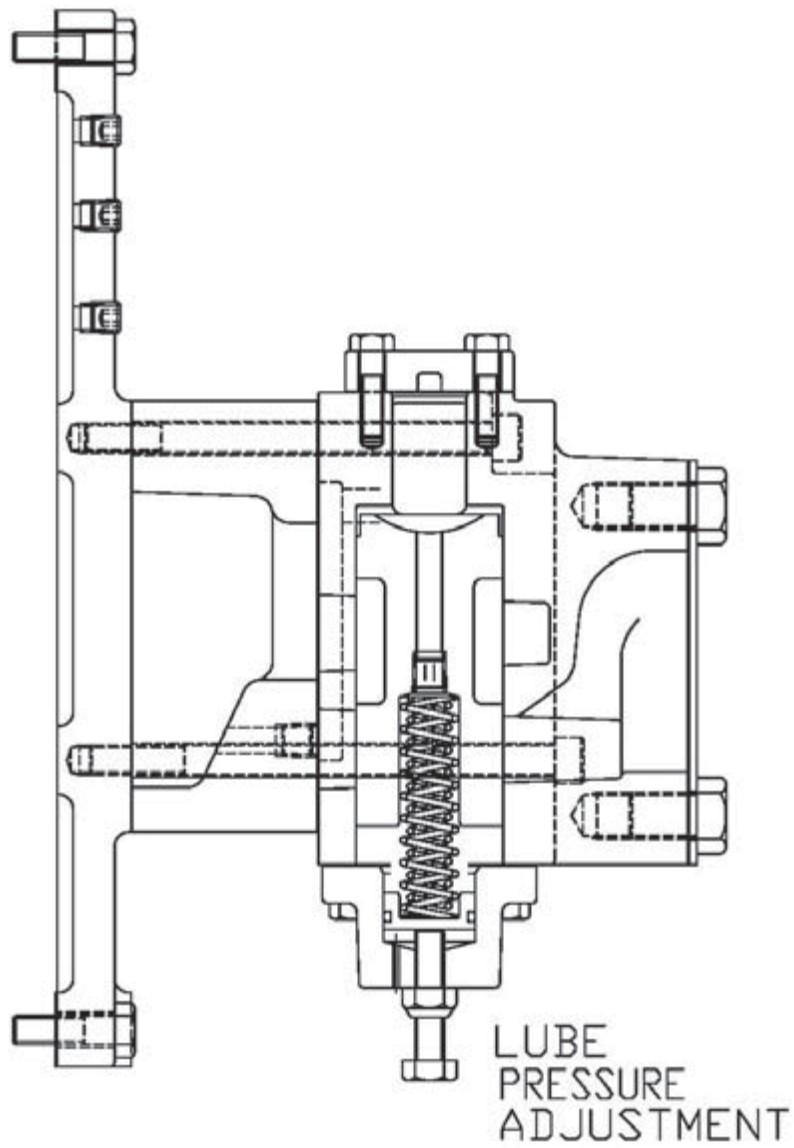


Figure 13. Lube Pressure Valve

Modulating Valve

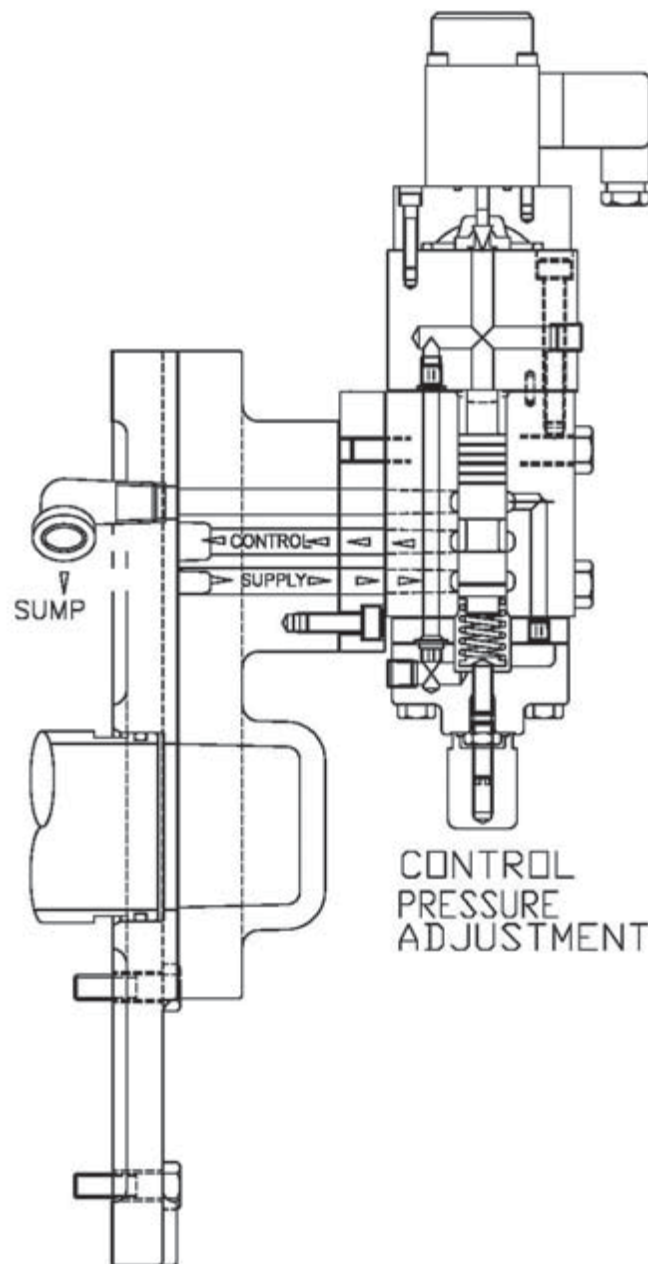


Figure 14. Electric Modulating Valve (Control Pressure)

Torque Values for Fasteners

Note: Lubricate all threads and bearing face with light oil film prior to assembly.

Use Grade 5 and Property Class 8.8 specs when threading into aluminum.

Table 1. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
M6	6.5 - 7.5	9-10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	968 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 2. U.S. Standard Fine and Coarse Thread Capscrews, Bolts, and Nuts

Thread Diameter	SAE Grade 5		SAE Grade 8	
	ft-lb	Nm	ft-lb	Nm
1/4	6 - 8	8 - 11	10 - 12	14 - 16
5/16	13 - 17	18 - 23	20 - 24	27 - 32
3/8	25 - 29	34 - 39	35 - 41	48 - 55
7/16	37 - 43	51 - 58	55 - 65	75 - 88
1/2	60 - 70	81 - 95	83 - 97	113 - 131
9/16	82 - 98	111 - 132	120 - 140	163 - 190
5/8	120 - 140	163 - 190	165 - 195	224 - 264
3/4	205 - 245	278 - 332	295 - 345	400 - 467
7/8	330 - 390	448 - 528	470 - 550	638 - 745
1	495 - 585	671 - 793	715 - 835	970 - 1132
1 1/8	615 - 735	834 - 997	1015 - 1185	1377 - 1606
1 1/4	850 - 1000	1163 - 1355	1375 - 1625	1865 - 2203

Operation

General

The MCD is a variable speed drive through which power is transmitted by a modulated clutch. The clutch comprises a stack of plates separated by belleville washers, and free to move axially. Alternate plates mesh with the drive and driven shafts.

Hydraulic control pressure is applied to a governor (omega valve) on the output shaft which governs the pressure applied to the clutch piston. Control pressure is set by an electronic controller that operates on an output speed closed loop regulation mode. The controller continuously compares the speed of the output shaft to the control setpoint, and adjusts the pressure accordingly.

Speed and steering control is accomplished with the usual joystick. The system switches automatically from one mode to the other. The captain has control of the full speed range acting on the MCD and the engine throttle without altering control procedure.

The MCD is designed for operation in three different modes:

- Normal Mode
- Emergency Mode
- Fire Fighting Mode

Normal Operating Mode

In the normal operating mode, the MCD clutch has two distinct working phases: modulating and lock-up.

Phase 1 or Modulating Phase

In this working phase, the prime mover runs at idling speed. The output speed can be adjusted from a minimum speed up to engine speed. This variation in output speed is obtained by moving the control lever from its neutral position of 0° to an angle of 30° . This modulation angle can be preset at any value around 30° . In this working phase, output speed "N2" is always below input speed "N1," except when the control angle reaches 30° , at which point the clutch is completely engaged, i.e. $N1 = N2$.

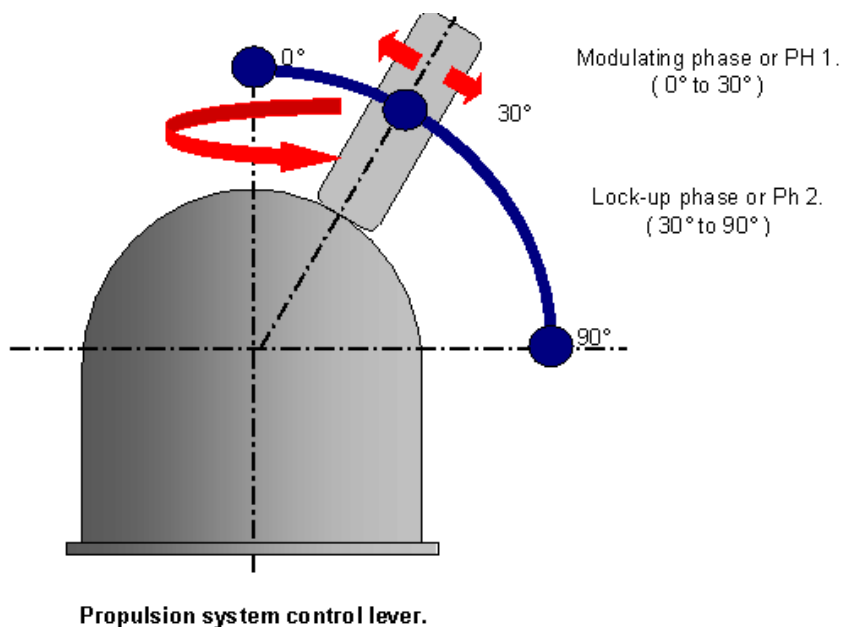


Figure 15. Propulsion System Control Lever

Control pressure is not applied directly to the piston; it controls a centrifugal governor called the "omega valve."

A small radial piston rotates with the output shaft and is thus subject to the centrifugal force (F_c) resulting from its rotation. This force is constantly balanced by the control pressure, which acts in the opposite direction. The governor applied pressure to the clutch is that required to keep the MCD output running at a preset speed proportional to that control pressure. Thus, the MCD is regulated by output speed and not, like conventional clutches, by torque transmitted.

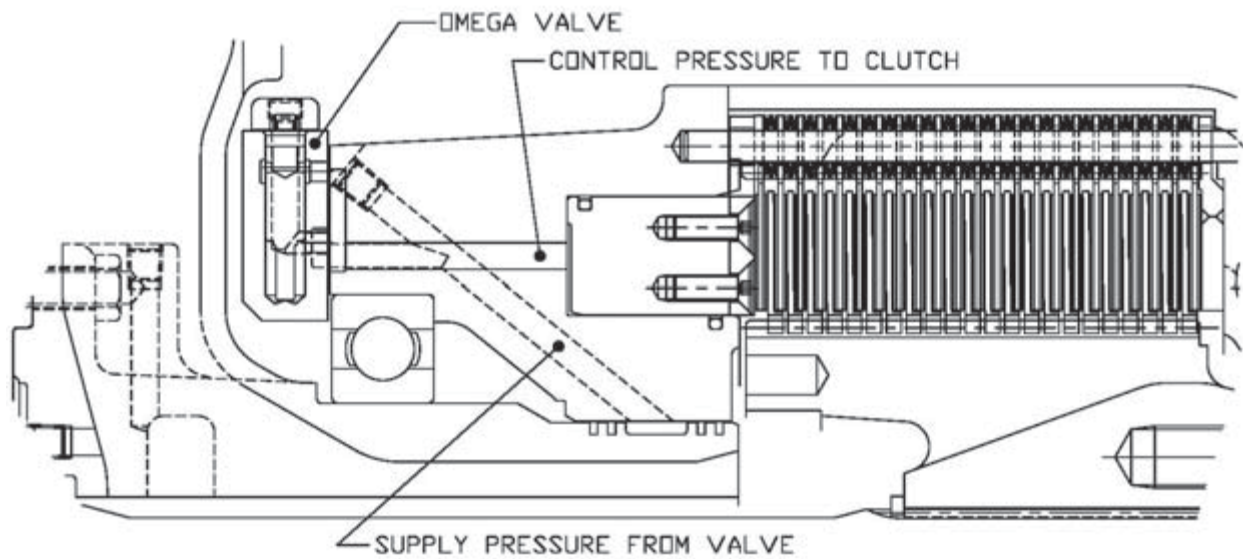


Figure 16. Clutch Control

The pressure required to operate the MCD is controlled by a servo-valve with DC power supply from the electronic controller. In the event of electrical failure, the required pressure can be controlled by a manual needle valve. In the event of hydraulic failure, the MCD is provided with a safety device to lock the clutch mechanically.

Phase 2 or Lock-up Phase

In this working phase the clutch is always engaged, which means that the output speed is equal to the input speed, $N1 = N2$, whatever the main engine speed as long as it is above idling speed.

The electronic controller will allow the clutch to work in this phase only if the following conditions are met

- a. $N1 = N2$ (Clutch fully engaged).
- b. Control lever angle $> 30^\circ$.
- c. The green LED located on the display " $N1 = N2$ " is lit

In this working phase the electric signal from the control lever has no action on the engagement of the clutch. This displacement of the lever's only function is to activate the speed control system of the main engine.

Emergency Operating Mode

According to the type of problem encountered, there are three different emergency situations. The following is a description of the proper procedure to carry out each emergency situation.

First level of Emergency.

In case of a general electronic failure affecting the electronic controller, it is possible, if the 24 Vdc supply is still available, to completely engage the clutch by means of the emergency switch located on top left of the display.

Emergency switch

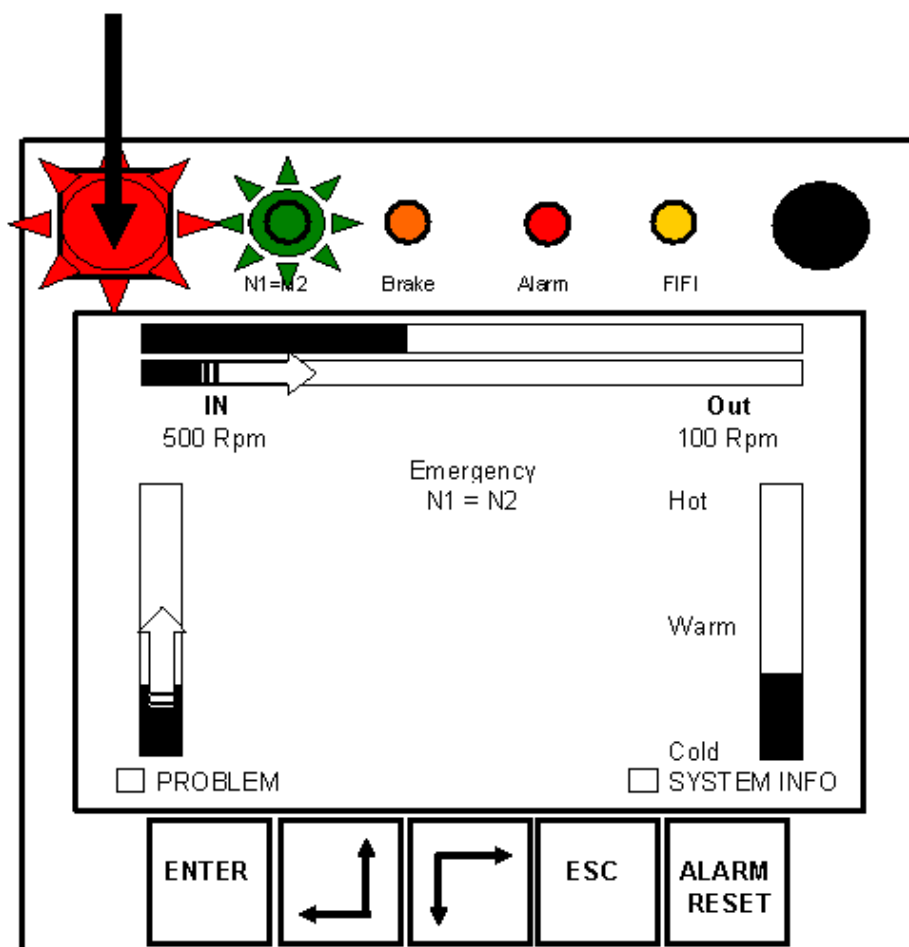


Figure 17. Emergency Switch

This emergency engagement of the MCD follows a slow rate in order to engage the clutch progressively from disengaged to fully engaged position.

Second level of Emergency

In case of power supply shut down affecting the electronic controller (black out) or problem with the servo-valve, it is possible to engage the clutch manually by means of a needle screw located on the servo-valve.

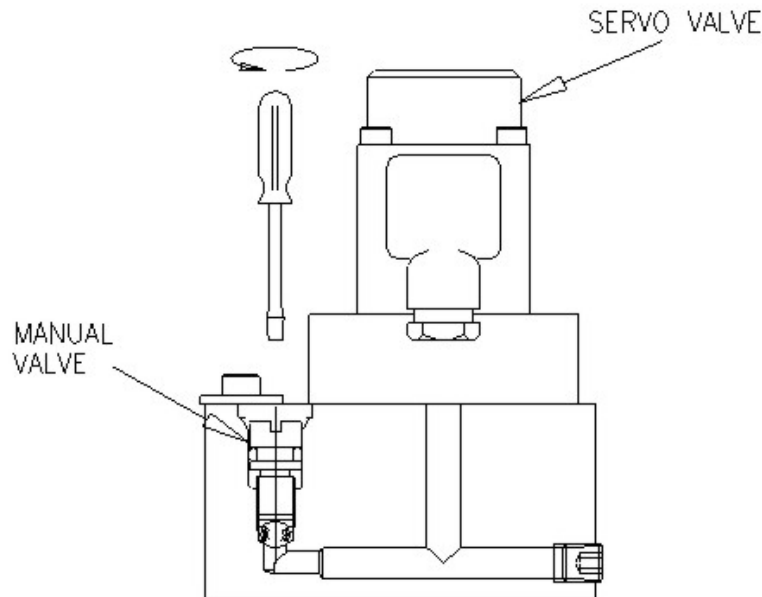


Figure 18. Manual Engagement Valve

To engage the clutch, turn this needle valve screw clockwise. The control pressure, and therefore the output speed, will increase progressively until the needle screw has reached its maximum position at which point, the control pressure is maximum.

⚠ CAUTION

Do not forget to remove the connector from the servo-valve to avoid random arrangement of the MCD. If the output shaft is equipped with an automatic brake, make sure that the brake is fully released before engaging the clutch manually.

To disengage the clutch, turn the needle screw progressively counter-clockwise. The control pressure and therefore the output speed will drop until the needle screw has reached the screw stop at which control pressure is minimum.

⚠ CAUTION

In normal operating condition, this needle screw must always stay fully open.

Third level of Emergency

In case of a hydraulic problem affecting the MCD, it is possible to engage the clutch mechanically by means of the three emergency come-home screws located at the output side of the clutch.

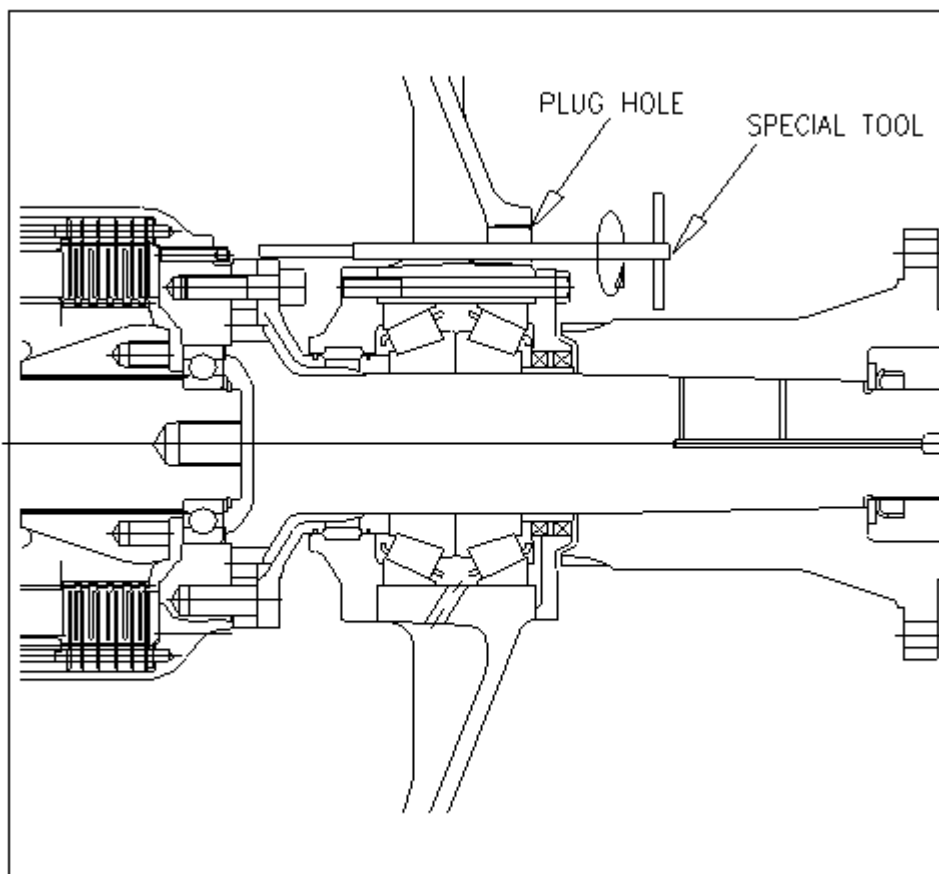


Figure 19. Mechanical Clamping of Clutch

⚠ CAUTION

Stop the engine and remove the three hexagonal plugs.

Turn the output shaft until the three emergency screws are directly in front of the three holes. Slip the emergency key, located on the unit, through the holes and turn the three emergency screws one by one, one turn at a time until all three screws are fully locked up.

Fire Fighting Mode

The following pertains to fire fighting application only.

In this operating mode the clutch slips permanently according to the position of the control lever. This permanent slippage allows the excess power from the to drive the fire-fighting pump situated at the opposite end of the engine crankshaft.

In this operating mode the prime mover speed is fixed at maximum speed. Action on the control lever from its zero position up to its maximum position of 90° allows variation of the clutch output speed from a minimum speed up to a fixed limited speed, which is less than the maximum speed of the prime mover. This upper limit represents about 70% of maximum prime mover speed.

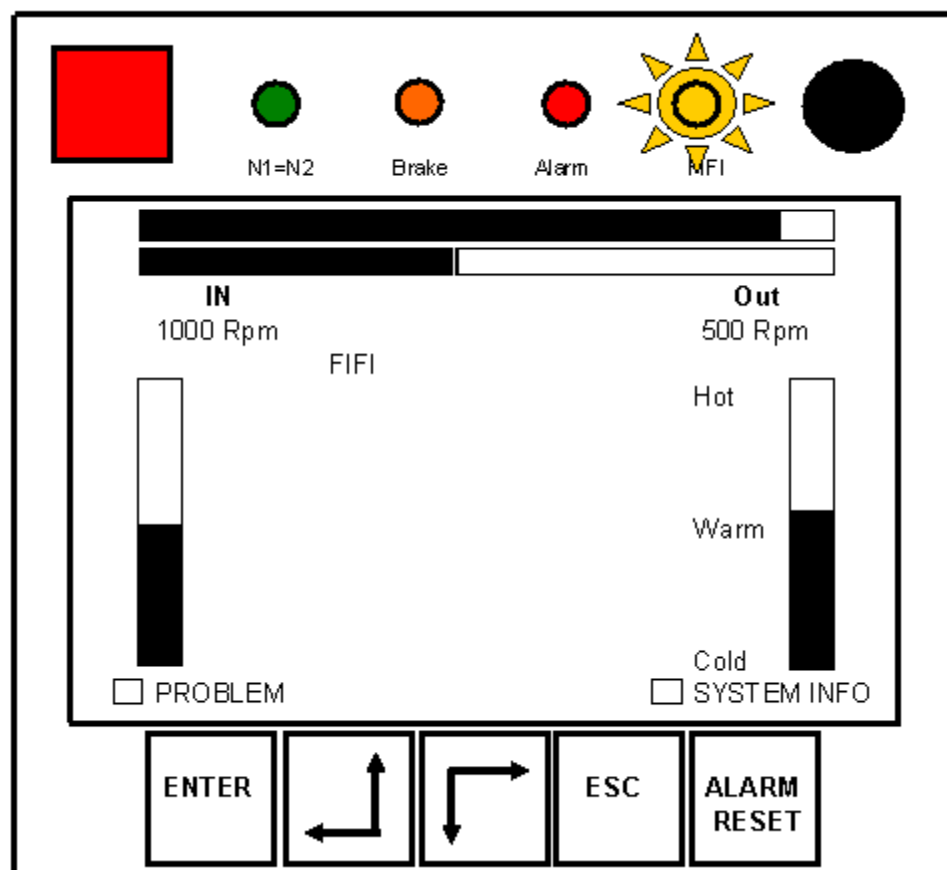


Figure 20. Controller in Fire Fighting Mode

Operating the Electronic Controller

General

At any time while operating the MCD, it is possible to access useful information that will help the maintenance engineer to optimize the use of the slipping clutch

The electronic controller display is composed of the following elements:

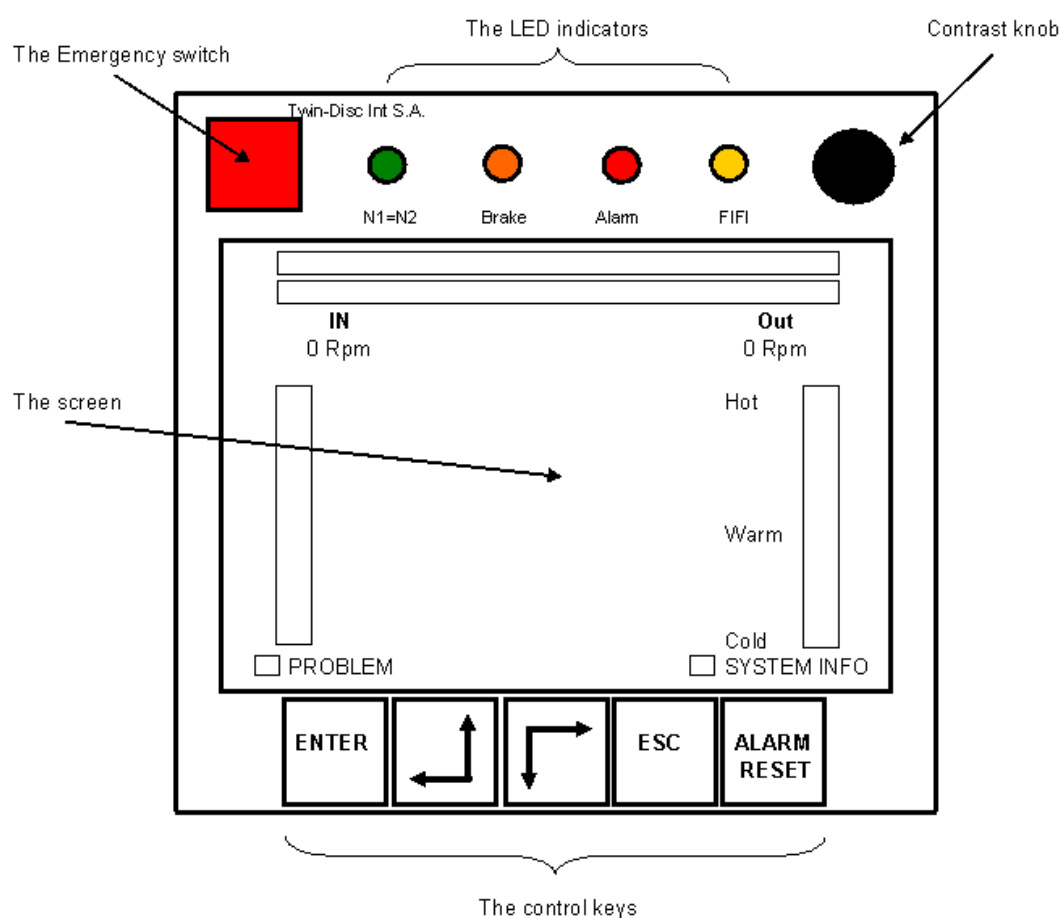


Figure 21. The Electronic Controller

The Screen

The screen displays the information selected by the user.

Emergency Switch

The Emergency Switch will cause the MCD to operate in emergency mode. A red light inside the switch will glow when the switch is activated. To return to normal operation, release the Emergency Switch; the red light will turn off.

LED Indicators

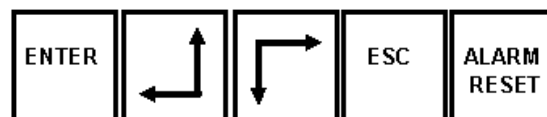
The LED indicators show in which state the MCD is operating:

N1 = N2:	The clutch is completely engaged.
Brake:	The brake is applied on the MCD output shaft.
Alarm:	The system is in alarm condition.
FIFI:	The MCD is operating in Fire-Fighting mode.

Contrast Knob

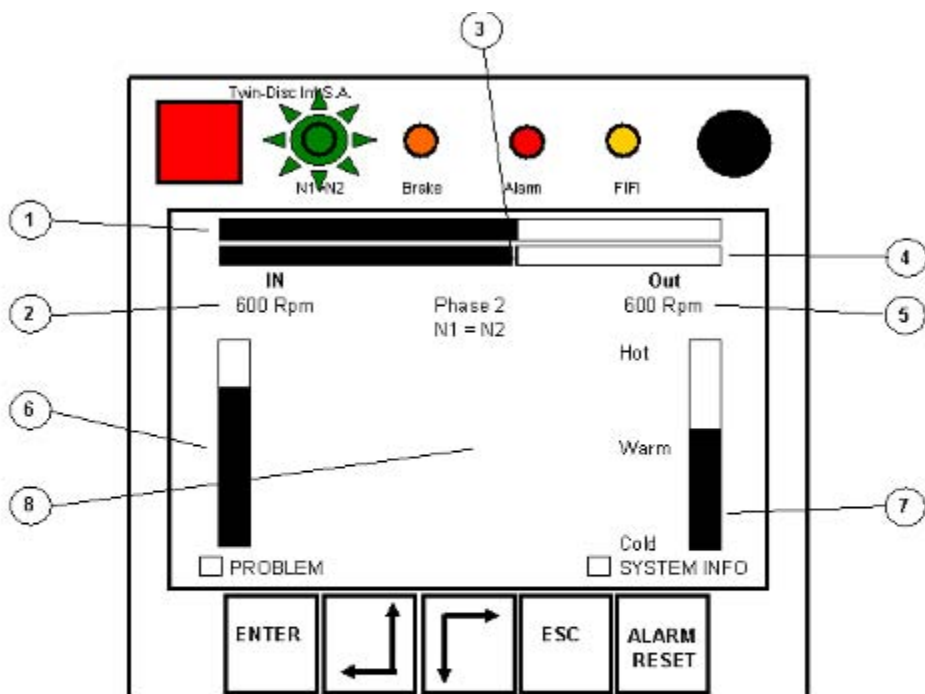
The Contrast Knob controls the display contrast to improve visibility of the screen whatever the light conditions in the wheel house.

Control Keys



Key	Action
Enter:	Validate the selected item.
Arrows (2):	Move the selector to desired item. Also, modify parameter values.
Escape:	Return to the previous screen, or leave an undesired selection.
Alarm Reset:	Reset MCD alarms.

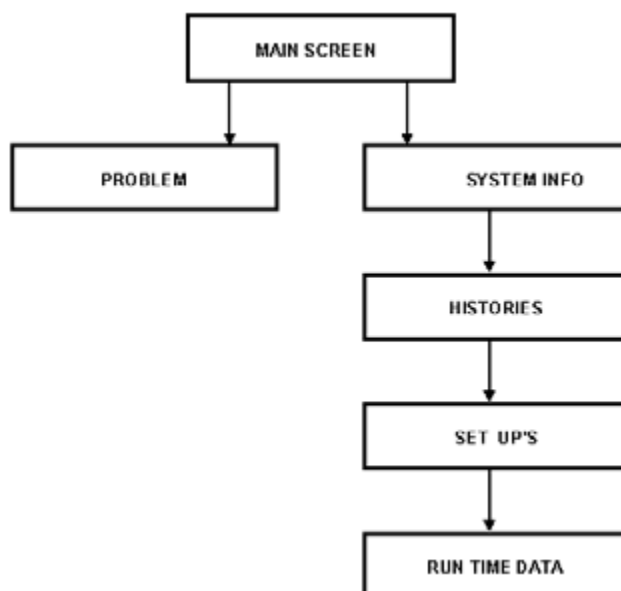
Main Screen



- | | |
|---|---|
| 1. Bargraph indicating input speed N1 | 6. Bargraph indicating control pressure applied to clutch |
| 2. Digit indicating input speed N1 | 7. Bargraph indicating lube oil temperature |
| 3. Digit indicating setpoint signal | 8. Area showing alarm message |
| 4. Bargraph indicating feedback signal (result) | |
| 5. Digit indicating feedback signal (result) | |

Figure 22. Main Screen

With the main screen displayed, move the selector to “PROBLEM” or “SYSTEM INFO” to display other screens.



Problem Screen

The problem screen provides, in detail, a list of all the problems affecting the MCD.

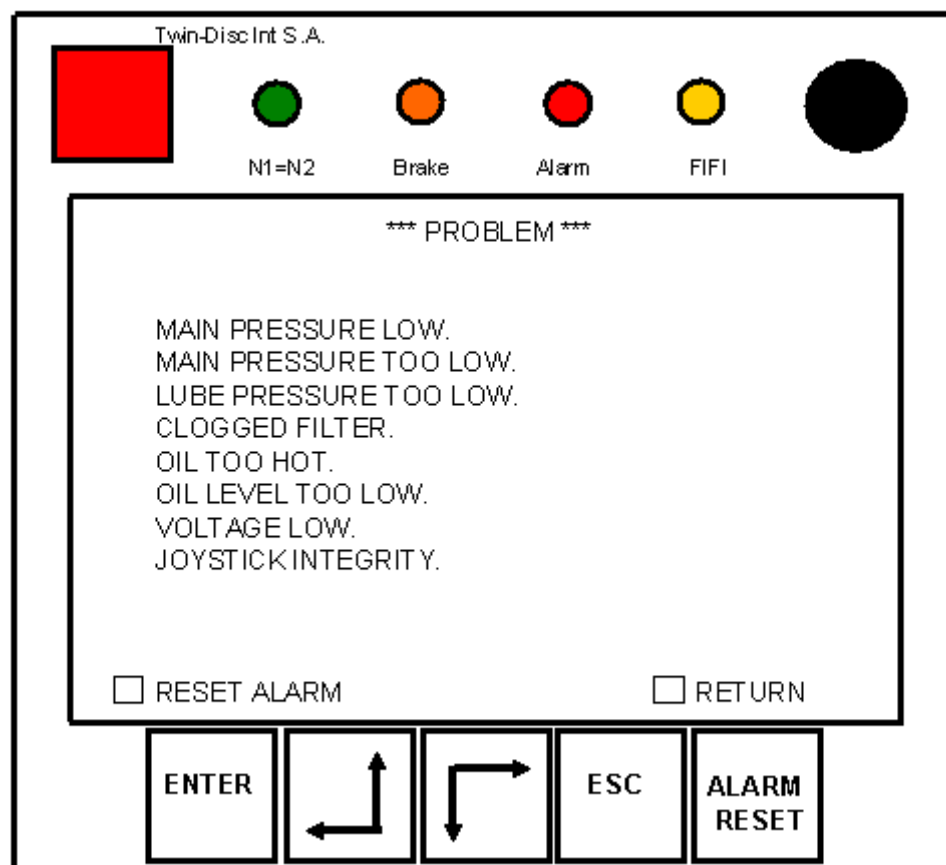


Figure 23. The Problem Screen

Select "RESET ALARM" to reset the alarm, or "RETURN" to return to the main screen.

System Information Screen



Figure 24. System Information Screen

With the system information screen displayed you can access other screens you want to view. Select “Histories,” “RunTimeData” or “SetUps,” and press the enter key.

History Screens

This menu provides two pages of records and can be divided into three groups of information: time, maintenance, and alarm.

Histories 1

Twin-Disc Int S.A.

☒ ☐ ☐ ☐ ☐ ☐

N1=N2 Brake Alarm FIF1

HISTORIES	
HRS IN SERVICE.	890
HRS IN PHASE 0.	50
HRS IN PHASE 1.	840
HRS IN PHASE 2.	0
HRS IN FIF1.	0
HRS IN EMERGENCY.	3
HRS IN OIL.	890
TIMES OIL CHGD.	890
HRS ON FILTER.	890
TIMES FILTER CHGD.	0
HRS ON CLGD FLTR.	0
TIMES FLTR CLGD.	0

☒ NEXT PAGE
 ☐ RETURN

ENTER   ESC ALARM RESET

Histories 2

Twin-Disc Int S.A.

☒ ☐ ☐ ☐ ☐ ☐

N1=N2 Brake Alarm FIF1

MIN IN OVERLOAD.	1
TIMES OVERLOAD.	1
MIN P2 CL SLIP.	0
TIMES P2 CL CLIP.	0
MIN OVER TEMP.	30
TIMES OVER TEMP.	0
HRS OIL LOW.	5
TIMES OIL LOW.	1
MIN MAIN P.LOW.	1
TIMES MAIN P.LOW.	56
MIN LUBE P.LOW.	35
TIMES LUBE P.LOW.	0
MIN FLT EMG LKUP.	0
TIMES FLT EMG LKUP.	0

☒ RETURN

ENTER   ESC ALARM RESET

Figure 25. History Screens

The controller permanently records useful data concerning the everyday operation of the MCD. The list below explains the items listed on the history screens.

Recorded Data and Legend

The MCD operating phases in hours:

HRS IN SERVICE Operating hours supply in 24 Vdc was on.
 HRS IN PHASE 0 Operating hours MCD disengaged.
 HRS IN PHASE 1 Operating hours MCD used in slipping phase.
 HRS IN PHASE 2 Operating hours MCD used in lock-up phase.
 HRS IN FIFI Operating hours MCD used in fire fighting mode.
 HRS IN EMERGENCY Operating hours MCD used in emergency mode.

Maintenance records

HRS IN OIL Operating hours since the last oil change.
 TIMES OIL CHGD Number of times the oil has been changed since
 start-up.
 HRS ON FILTER Operating hours since the last oil filter change.
 TIMES FILTER CHGD Number of times the oil filter has been changed
 since start-up.
 HRS ON CLGD FLTR Operating hours in which the filter was clogged.
 TIMES FLTR CLGD Number of times the filter was clogged since the
 last filter change.

Alarm records

MIN IN OVERLOAD MCD in overload in minutes.
 TIMES OVERLOAD Number of times MCD was in overload.
 MIN P2 CL SLIP MCD slipping in lock-up phase in minutes.
 TIMES P2 CL CLIP Number of times MCD was slipping in
 lock-up phase.
 MIN OVER TEMP MCD in over temperature in minutes.
 TIMES OVER TEMP Number of times MCD was in over temperature.
 HRS OIL LOW MCD oil level too low in minutes.
 TIMES OIL LOW Number of times MCD was in oil level low.
 MIN MAIN PLOW MCD in main pressure low in minutes.
 TIMES MAIN PLOW Number of times MCD main pressure was low
 MIN LUBE PLOW MCD in lubrication low in minutes.
 TIMES LUBE PLOW Number of times MCD lubrication was low.
 MIN FLT EMG LKUP MCD in Emergency mode in minutes.
 TIMES FLT EMG LKUP Number of times MCD was in Emergency mode.

Run time Data

This screen is available through the “SYSTEM INFO” menu and provides the user with real time data concerning the MCD control parameters.

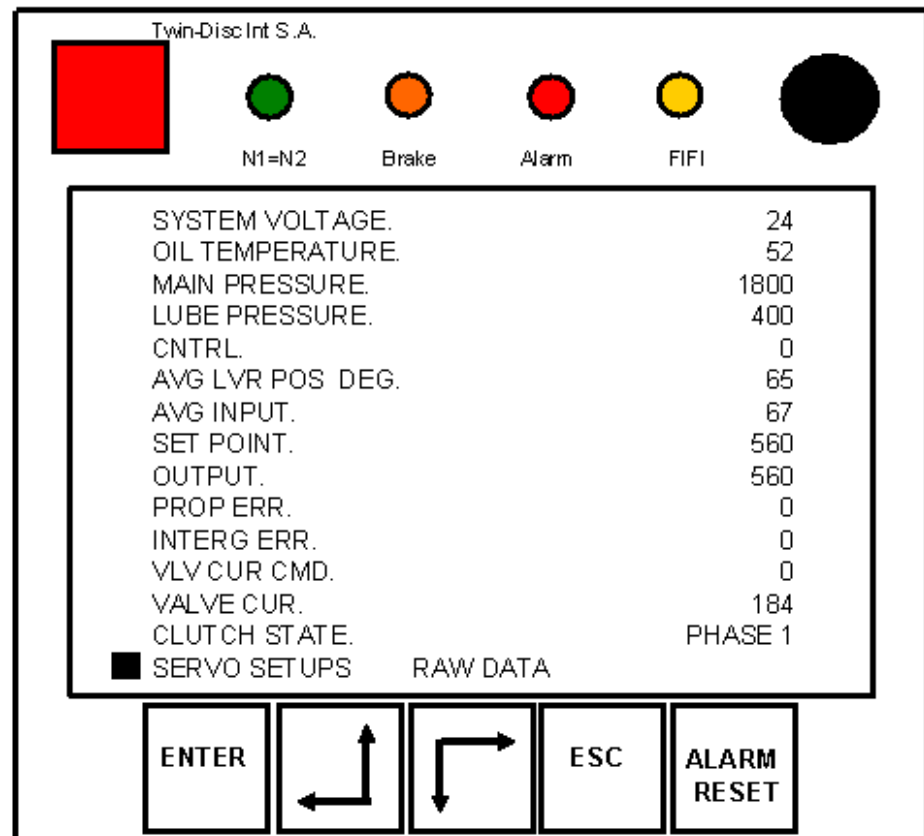


Figure 26. Run Time Data Screen

Recorded Data and Legend

SYSTEM VOLTAGE Power supply in 24 Vdc.
 OIL TEMPERATURE Oil temperature in °C.
 MAIN PRESSURE Main pressure in Kpa.
 LUBE PRESSURE Lubrication pressure in Kpa.
 CNTRL Control pressure (not connected).
 AVG LVR P05 DEG Position of Joystick in degrees.
 AVG INPUT
 SET POINT Set point signal;
 OUTPUT Feed back signal.
 PROP ERR Proportional error regulation.
 INTERG ERR Integral error regulation.
 VLV CUR CMD Digital value of control current to the servo-valve.
 VALVE CUR Control current to the servo-valve.
 CLUTCH STATE MCD operating state.

Setups Menu Screen

From the setups menu screen, sub-menus are available that define parameters for:

- Engine Configuration
- Input / Output Speeds
- Controller Performance
- Alarms Time Delays

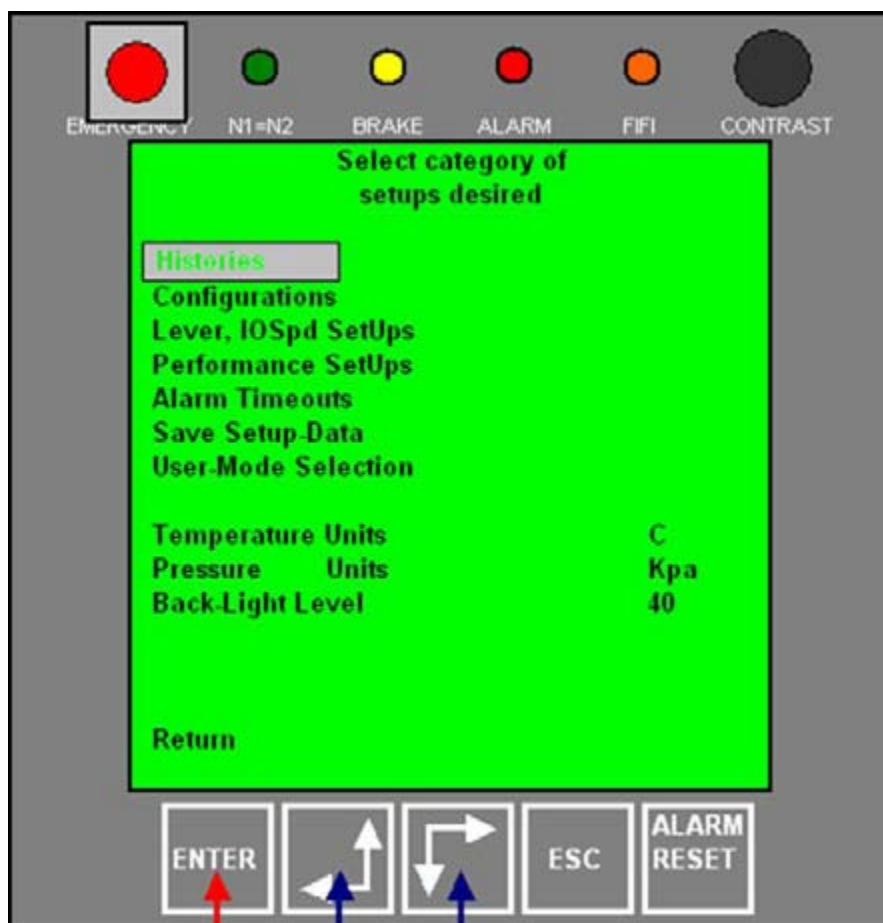


Figure 27. Setups Menu

With the arrow keys, move the selector to the feature you want to setup or change, and press the enter key.

Note: After you have completed the setup changes for each feature, be sure to return to this screen and save those changes. Select "Save Setup Data" and press the enter key.

Configuration Screen 1

This is the first of three configuration screens:

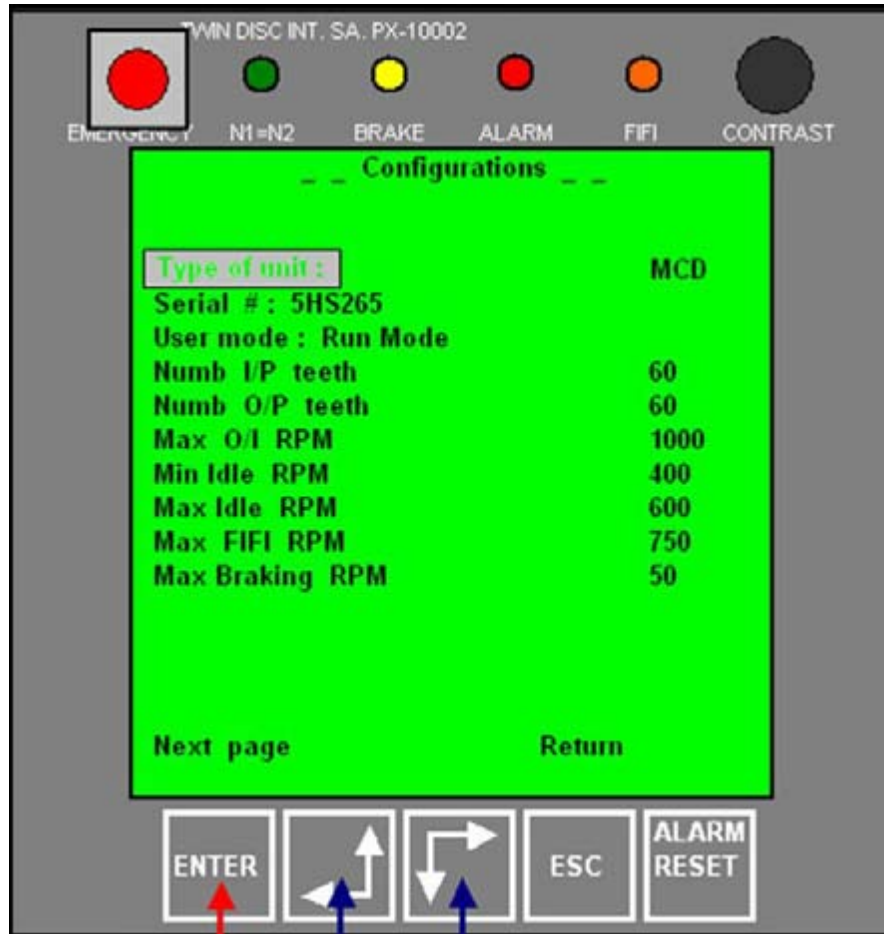


Figure 28. Speed Configuration Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the “Setups” screen, and save the changes you just made.

Configuration Screen 2

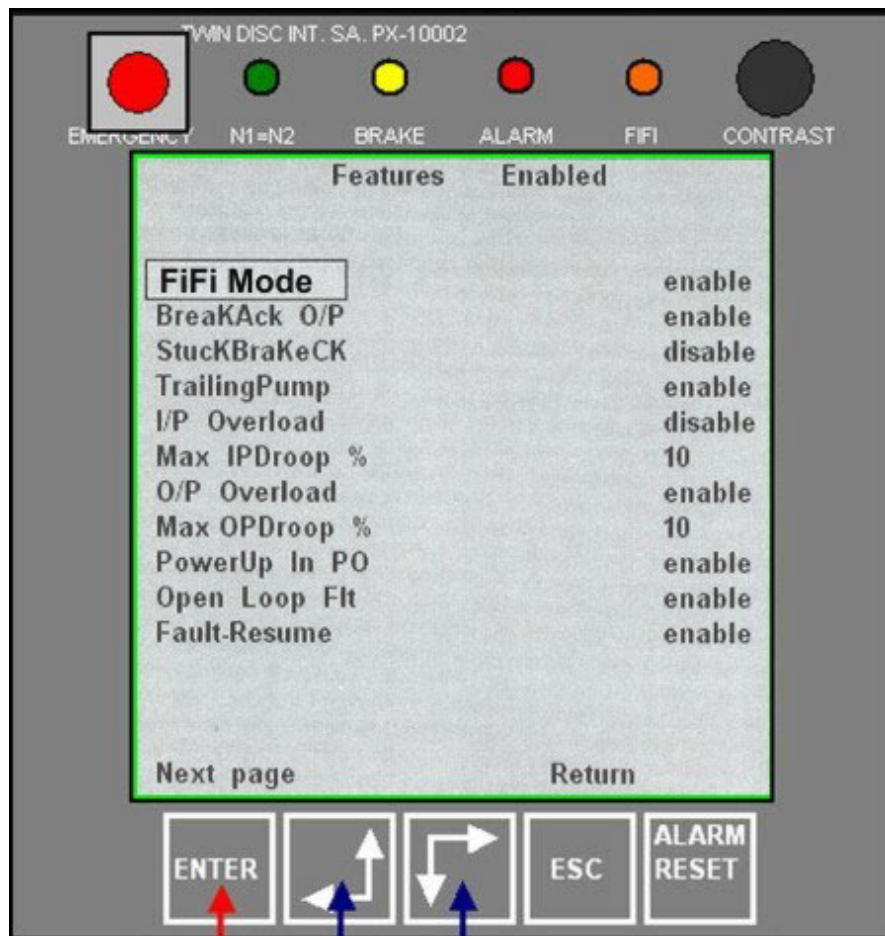


Figure 29. Features Configurations Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the "Setups" screen, and save the changes you just made.

Configuration Screen 3

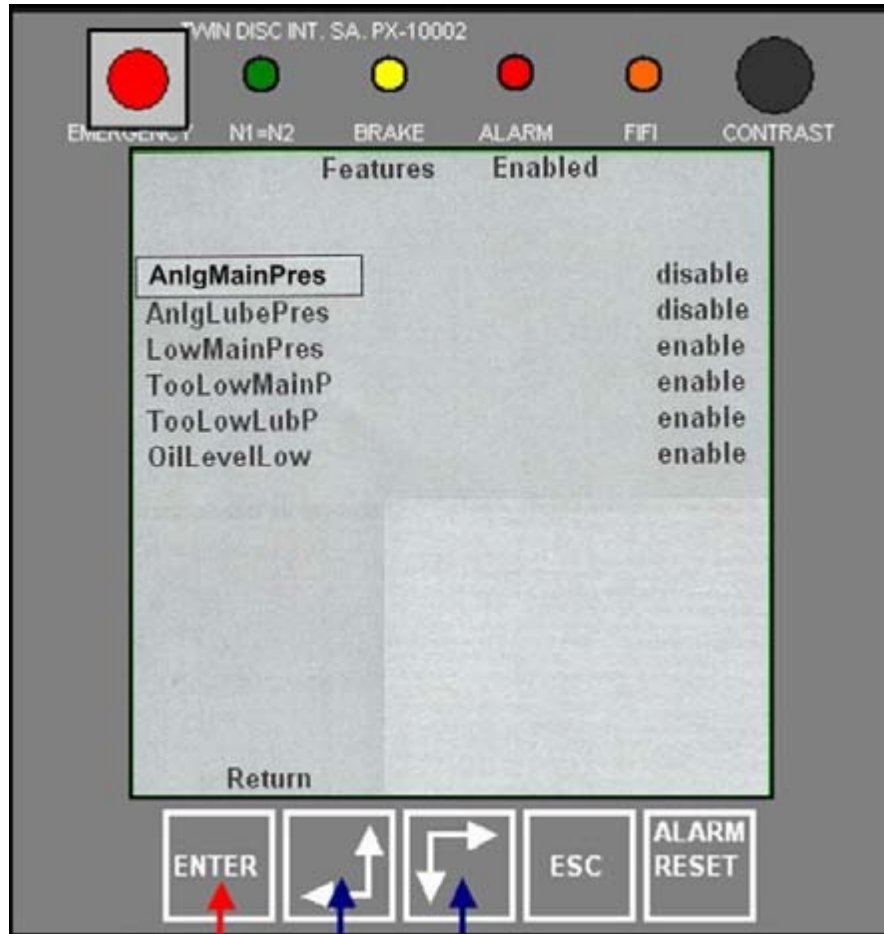


Figure 30. Alarm Features Configurations Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the "Setups" screen, and save the changes you just made.

Configuration Parameters Definitions

This table defines the configuration parameters listed on the configuration screens. It also specifies the values of those parameters that are set at the factory before the unit is shipped. Parameters that are not factory set are functions of a particular application and must be set when the unit is installed.

Table 3. Configuration Parameters

First Screen	Factory Setting	Definition
Type of unit		Model of MCD
Serial number	-	Serial number of MCD
Number of I/P teeth	60	Number of teeth on gear the input speed sensor is set to read.
Number of O/P teeth	60	Number of teeth on gear the output speed sensor is set to read.
Max I/P RPM		Maximum input RPM allowed
Min. idle RPM		Minimum input RPM allowed at idle
Max. idle RPM		Maximum input RPM allowed at idle
Max. FIF RPM		Maximum RPM allowed during fire fighting mode
Max. braking		Maximum RPM allowed to enable the brake authority relay
Second Screen	Factory Settings	
Fire fighting mode		Enables or disables Fire Fighting Mode
Brake ack. O/P		Enables or disables Brake Acknowledge Output
Stuck brake on		Enables or disables brake on input
Trailing pump	Enable	Enables or disables trailing pump option
I/P overload	Disable	
Max I/P droop %	-	
O/P overload	Enable	
Max O/P droop %	10	
Power up in phase 0	Enable	When enabled the MCD powers up in Phase 0
Open loop fault	Enable	
Fault resume	Enable	When enabled the MCD continues to operate while in fault mode
Third Screen	Factory Settings	
Analog main pressure	Disable	Enables or disables the analog main pressure input to the MCD
Analog lube pressure	Disable	Enables or disables the analog lube pressure input to the MCD
low main pressure		Enables or disables the low main pressure warning / fault
Too low main pressure		Enables or disables the too low main pressure warning / fault
Too low lube pressure		Enables or disables the too low lube pressure warning / fault
Oil level low		Enables or disables the oil level low warning / fault

I/O Parameter Screen

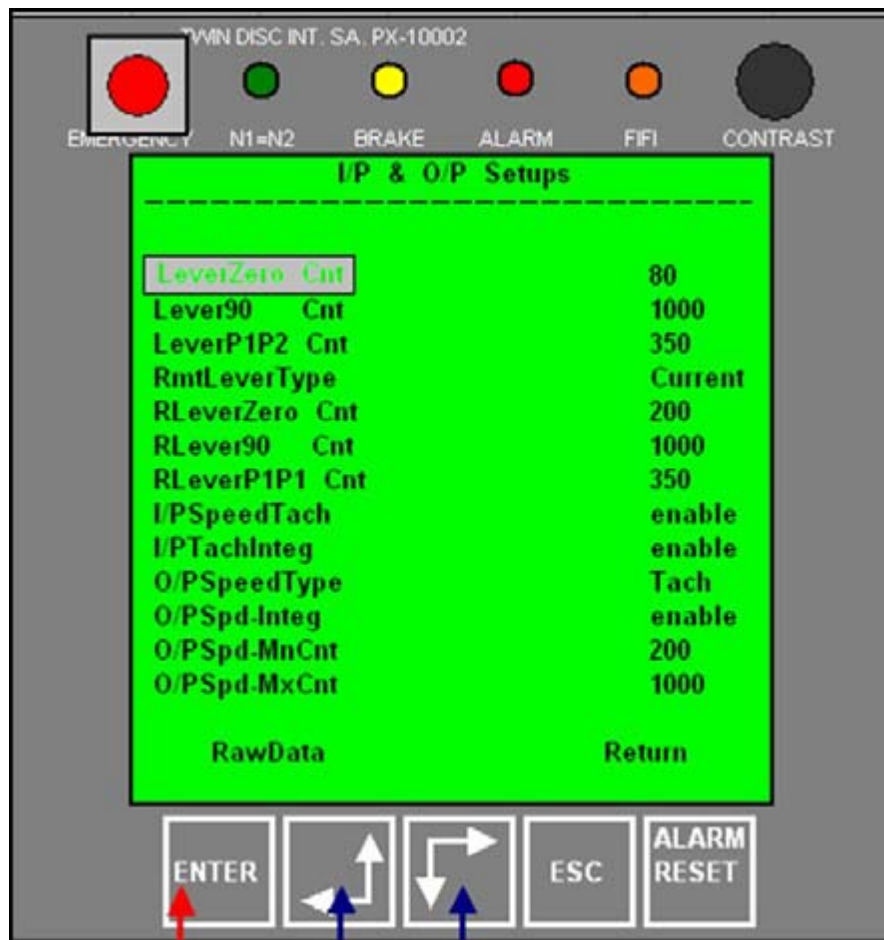


Figure 31. Lever, Input and Output Speeds Setup Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the "Setups" screen, and save the changes you just made.

I/O Parameter Definitions

This table defines the input and output parameters listed on the setup screen. It also specifies the values of those parameters that are set at the factory before the unit is shipped. Parameters that are not factory set are functions of a particular application and must be set when the unit is installed.

Table 4. Input / Output Parameter Definitions

Lever, Input and Output Speed Setups	Factory Settings	Definition
Lever zero CNT.		The calibrated lever count position at the zero degree position
Lever 90° CNT.		The calibrated lever count position at the ninety degree position
Lever P1 - P2.		The calibrated lever count position at the Phase 1 - Phase 2 transition (thirty degrees)
Remote lever type.	Not Used	Enables either a current or voltage signal from the remote lever when a remote lever is used
Remote zero CNT.		The calibrated remote lever count position at the zero degree position
Remote 90° CNT.		The calibrated remote lever count position at the ninety degree position
Remote P1 - P2 CNT.		The calibrated remote lever count position at the Phase 1 - Phase 2 transition (thirty degrees)
Input speed tach.		Enables or disables input speed tachometer signal
Input tach integrity.		Enables or disable the integrity checking of the input tachometer
Output speed type.		The output speed signal type used
Output tach integrity.		Enables or disable the integrity checking of the output tachometer
Output speed min CNT.	Not Used	
Out speed max CNT.	Not Used	

Performance Data Screen

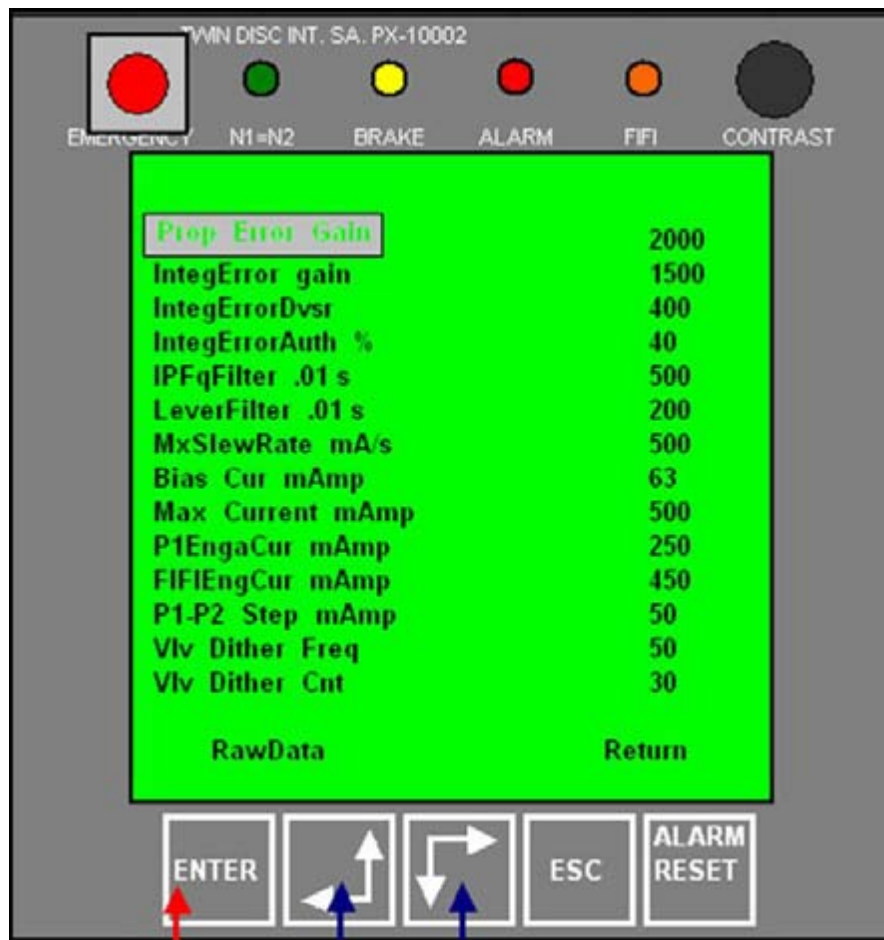


Figure 32. Controller Performance Setup Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the "Setups" screen, and save the changes you just made.

Performance Parameter Definitions

This table defines the controller parameters listed on the setup screen. It also specifies the values of those parameters that are set at the factory before the unit is shipped. Parameters that are not factory set are functions of a particular application and must be set when the unit is installed.

Table 5. Performance Parameters

Performance Data	Factory Settings	Definition
Proportional error gain	1000*	A high proportionnal gain given a quick response on the output (rpm) UCD or MCD at a step of set point signal requested, gain too high given an unstability on the out put shaft.
Integral error gain	1400*	
Integral error divisor	500*	
Integral error auth %	75*	
Input filter (0.1 Sec)		
Lever filter (0.1 Sec)		
Max slew rate (mA/Sec)		
Bias current (mA)		
Max current (mA)		
P1 engagement current (mA)		
FIFI engagement current (mA)		
P1-P2 step		
Valve dither (Hz)	31	
Valve dither (Hz)	16	
* = Adjusted only by authorized Trained Twin Disc Service personnel		

Alarm Timeouts Screen

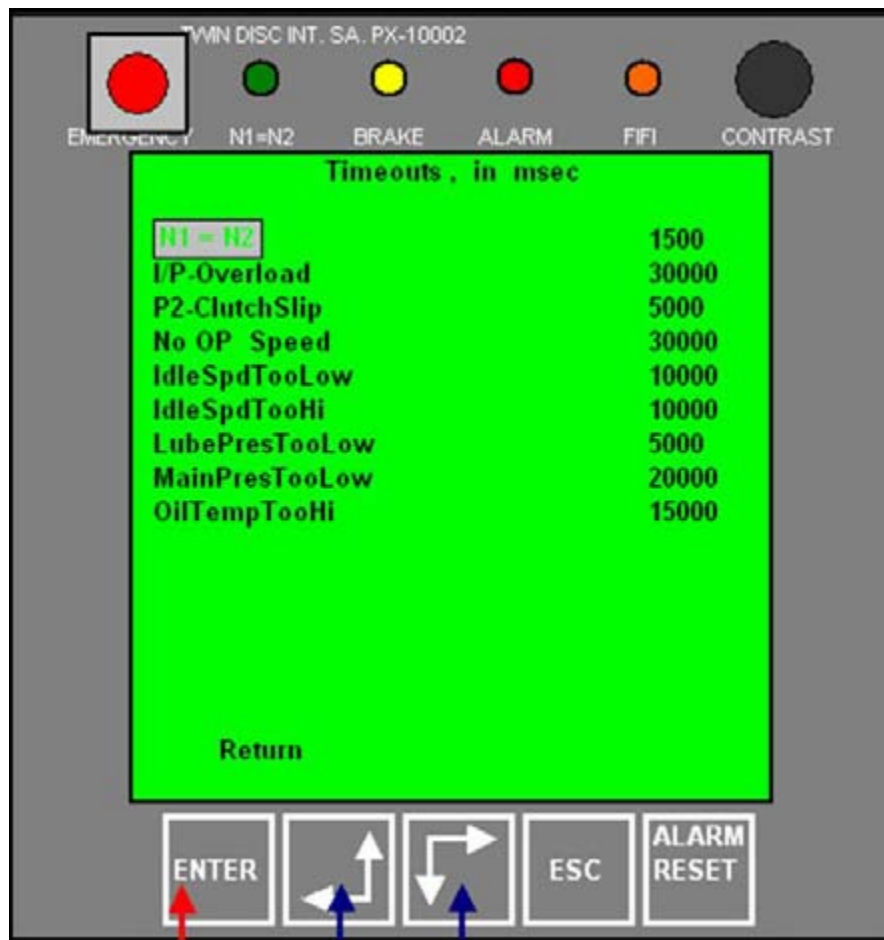


Figure 33. Timeouts Screen

1. With the arrow keys, move the selector to the parameter you want to change, and press the enter key. The selector moves to the parameter value.
2. With the arrow keys, change the value of the parameter and press the enter key.
3. Repeat steps 1 and 2 as necessary. Then, press the escape (ESC) key to return to the main screen. Remember to return to the "Setups" screen, and save the changes you just made.

Timeouts Parameters Definitions

This table defines the parameters listed on the timeouts setup screen. It also specifies the values of those parameters that are set at the factory before the unit is shipped. Parameters that are not factory set are functions of a particular application and must be set when the unit is installed.

Table 6. Timeouts

Timeouts (in milliSec)	Factory Settings	Definitions
N1=N2	1500	The time needed prior to N1=N2 signal is given; Allows activation on the main engine throttle.
Input overload	30000	The time allowed during a input overload warning before the overload fault occurs; Rarely Used
P2 clutch slip	5000	The time allowed for a clutch slippage warning in Phase 2 before the P2 clutch slip fault occurs; Alarm displayed - MCD Disengaged automatically
No output speed	30000	The time allowed to have no output speed warning during Phase 1; Only in Ph1; Alarm displayed - MCD Disengaged automatically
Idle speed too low	10000	The time allowed to have too low of idle speed warning before a fault occurs; Alarm displayed - MCD Disengaged automatically
Idle speed too high	10000	The time allowed to have too high of idle speed warning before a fault occurs; Alarm displayed - MCD Disengaged automatically
Lube pressure too low	5000	The time allowed to have too low of lube pressure warning before a fault occurs; Alarm displayed - MCD Disengaged automatically
Main pressure too low	20000	The time allowed to have too low of main pressure warning before a fault occurs; Warning displayed - No effect on the MCD operation
Oil temperature too high	15000	The time allowed to have too high of oil temperature warning before a fault occurs; Warning displayed - No effect on the MCD operation

Trailing Pump

A minimum lubrication is required when prime mover is stopped and the MCD's output is turning by trailing. The trailing pump is mounted on the top cover of MCD and all piping and valves are already connected from the sump to the lubrication circuits (bearings and clutch parts).

The start-up of this system is controlled by the electronic control PX-1 0001. The trailing pump is activated when these two conditions are realized:

- Main engine stopped.
- MCD's output shaft running over 50 RPM

The trailing pump lubrication pressure can be checked on the lubrication gauge and its value must be estimated at 1.5 Bar (21.8 psi) .

To avoid damage to the MCD unit, the electrical supply to the control must be on at all times.

The trailing pump is also used to drain the oil from the MCD sump. During this mode, the main engine must be stopped, the drain valve lever must be in the DRAIN position (refer to drawing PX 11050A), and the blue pushbutton on the starting box must be positioned IN.

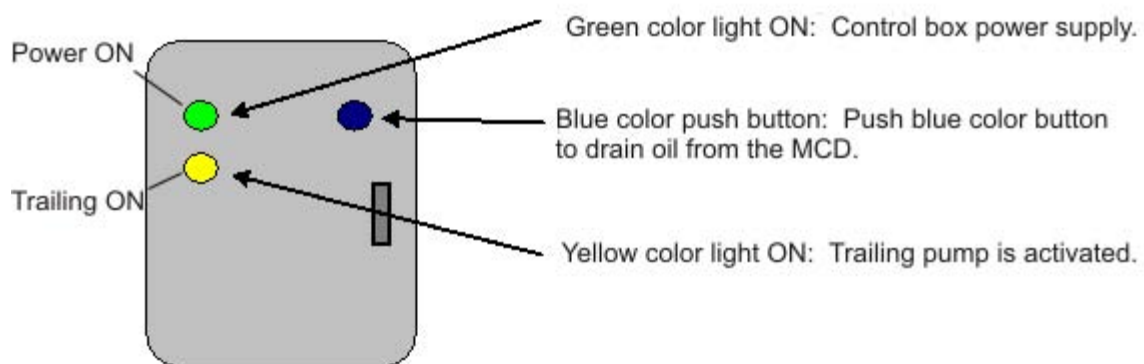


Figure 34. Control for Trailing Pump

Preventative Maintenance

Periodic Visual Inspection

- Check unit mounting for tightness or damage such as cracks, etc.
- Check heat exchanger pipework for leaks or damage
- Check correct operation of pressure and temperature gauges and switches
- Check input and output flanges for tightness
- Check the unit for external oil leaks and check all external hydraulic connections for tightness

Cooler Inspection

Check the following items :

- Have the cooler and the system been vented properly?
- Are the flows according to specification?
- Are shell and tube side clean? Failing to do that can cause a drop in performance and an increased pressure loss.

Electronic Aided Maintenance

The electronic controller provides information concerning maintenance of the MCD. This information is available in the “HISTORIES” section.

Lubrication

All moving parts of the MCD clutch are lubricated by the oil as it travels through the hydraulic system. No other lubrication is required beyond the daily oil level check.

Overhaul Interval

A complete overhaul of the unit should be carried out at the same time that the prime mover is overhauled. All parts showing signs of wear should be replaced at this time.

Suction Screen

The suction screen should be removed and cleaned every 3000 hours of operation or more often if conditions warrant. The suction screen should be cleaned whenever the oil is changed even if the two periods do not coincide.

Oil Change

The oil should be changed every 3000 hours of operation. Drain the unit using the drain valve located at bottom on the filter side. Drain the cooler and associated pipings. Use the oil filler cap/breather to fill the unit. It is equipped with a filter screen. With the engine stopped, fill the unit to the maximum level mark on sight glass.

With the engine running, add oil to bring the maximum mark of the oil gauge. Final adjustment of the oil level should be performed with the engine running at idling speed and the oil at normal operating temperature.

Oil Filling

The MCD is supplied with an oil filling plug equipped with an air breather. Oil level can be checked on a sight glass located on the side of the unit.

Oil **must** be per the following specification:

AUTOMATIC TRANSMISSION FLUID DEXTRON II TYPE

The oil must be ATF and certified to pass Caterpillar TO-2 or Allison C-4 transmission fluid specification.

Commonly used oils include:

ESSO	Torque Fluid 56
TEXACO	Textran TDH Premium
SHELL	DONAX TD

Oil Level

Oil level should be checked daily. Check the oil level with the engine running, and the oil at normal working temperature. Add oil as necessary to bring the level to the “maximum” mark on the sight glass.

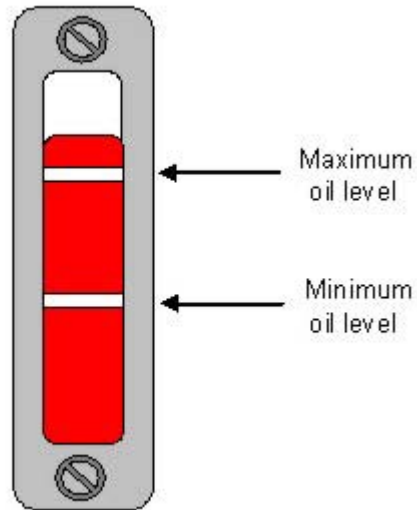


Figure 35. Oil Level Sight Glass

Troubleshooting

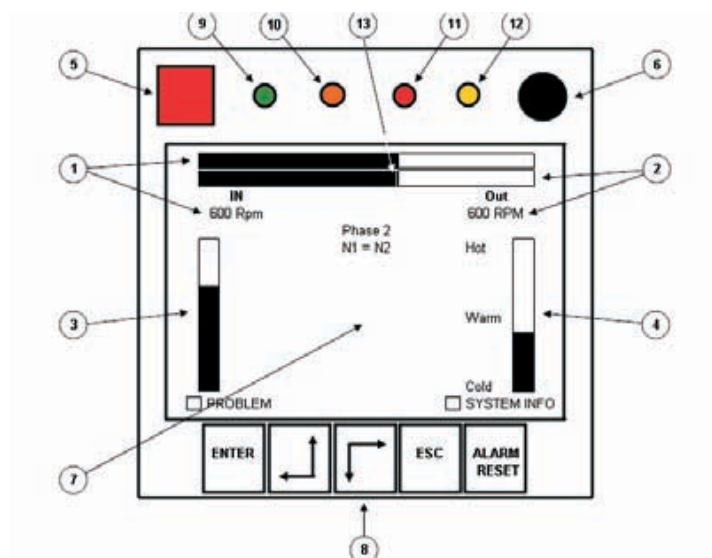
General

The MCD is one part of a complete power package. Problems in the input power system, output power delivery components, input or output speed pickups, engine speed, etc. can cause problems to develop in the MCD. It is therefore important that the entire power package be considered when problems are encountered.

Many of the faults with the MCD will be identified on the Electronic Interface Display, but some may not be identified. There are two troubleshooting tables that follow. The first table discusses the problems that are identified on the Electronic Interface Display. The second table discusses some of the problems that may not be identified on the display.

Troubleshooting the MCD with Electronic Interface

The electronic display provides the user with a wide range of information. Legend of information that is available on the display screen:



1. Bargraph and data indicating the input speed.
2. Bargraph and data indicating the feedback signal.
3. Bargraph indicating the control pressure.
4. Bargraph indicating the lube oil temperature.
5. Emergency switch.
6. The screen light contrast knob.
7. Area listing the MCD problem.
8. The control keys.
9. Spotlight indicating the MCD is fully engaged: $N_1 = N_2$.
10. Spotlight indicating the MCD is fully disengaged. The brake is applied on the MCD output shaft (optional).
11. Spotlight alarm indicating MCD fault.
12. Spotlight indicating the MCD is in the FIFI (fire fighting) mode.
13. Setpoint signal.

Alarm Control

The electronic controller displays different messages which are classified in two categories: warnings and faults.

Warnings inform the user of potential problems affecting the MCD. If the problem still exists after a pre-set time delay (timeout), the warning becomes a fault. A message on the screen indicates if the message is a warning or a fault. Select the problem section on the main menu to obtain more details.

The following table lists all possible warnings or faults that can occur during operation of the MCD.

Table 7.

Troubleshooting of MCD with Electronic Interface

MESSAGE			CAUSE	REMEDY
Category	Displayed	Explained		
Warning	Oil level too low	Oil level below pre-set value	Wrong oil filling or oil leak	Adjust oil level
	Fault Condition Oil too hot	Oil temperature too hot above 105 degrees	Improper oil level	
			Faulty oil cooler	
			Clutch slipping in lock-up	
			Bearing failure	
			Air leak on suction side of pump	
			Lube valve malfunction	
	Filter Clogged	Oil filter clogged switch is open	Dirt in hydraulic system	Replace filter element
			Defective filter clogged indicator or electrical connection	Check and/or replace clogging indicator. Check wiring and connector
	Alert Condition Main pressure low	Main pressure below pre-set value	Clogged oil filter or oil strainer	Replace or clean
			Contamination of main valve	Disassemble main pressure regulating valve and clean; replace O-ring
	Alert Condition Main Pressure too low	Main pressure too much below pre-set value	Damaged or worn oil pump	Replace oil pump assembly
			Engine speed too low	Adjust engine speed per specification
			Pressure adjustment loose	Adjust main pressure at screw below main regulating valve

Table 7. (continued)

Troubleshooting of MCD with Electronic Interface

MESSAGE			CAUSE	REMEDY
Category	Displayed	Explained		
Fault	Fault shutdown clutch slip	Slipping in lock-up phase	Clutch pressure too low	Check and adjust control and main pressure
			Mechanical failure in clutch	Overhaul clutch
	Fault condition IP or OP tach lost	Loss of input or output speed signal	Loose electrical connection	Check wiring and secure wire
			Loose connector	Check connection and tighten correctly
			Failed speed pick-up	Replace speed pick-up (Resistance +/- 1000 ohm)
			Wrong air gap of speed pick-up	Adjust air gap (0.4 - 0.6 mm) (0.016 - 0.024")
	Fault shutdown IP speed too high	Engine speed too high	Engine speed out of adjustment	Adjust engine idling speed per specification
	Fault IP speed too low	Engine idling speed too low		
	Alert condition - Joystick integrity	Joystick lever line open (lost)	Incorrect setpoint signal	Adjust signal to be min. 0.2 Vdc, max. 5 Vdc
			Potentiometer under joystick out of adjustment, or microprocessor out of adjustment -- depending on application	
	Alert condition - Remote integrity	Remote lever line open (lost)	Remote lever line lost or open	Verify signal is between 4 and 20 mA
	Fault shutdown - Lube too low	Lube pressure too much below pre-set value	Pump flow too low	Replace pump
			Lube valve out of adjustment	Adjust lube pressure per specification
			Piston is sticking in valve	Disassemble valve and clean
			Air leak on suction side of pump	Inspect and correct cause of leak
			Internal leak in the clutch; broken piston rings	Open clutch; inspect and replace damaged parts
	Voltage low	Power supply below 19 volts	Defective power supply	Check; adjust or replace
		Lock-up cannot be selected	Conditions for lock-up are not present (achieved)	N1 = N2 Control lever must be at 30 degree angle New adjustment required

MCD Clutch Remains Disengaged

Table 8. Troubleshooting

Symptom		Cause		Remedy	
1-1.	Mechanical or hydraulic failure.	1-1.	Main pressure low.	1-1.	Check oil level at sight glass.
					Check oil suction strainer; clean if necessary.
					Check oil filter; replace element if necessary. Filter is provided with a by-pass valve and "clogged filter" electrical switch. Verify the by-pass piston is not jammed.
					Verify the main pressure valve is properly adjusted with screw; is in good condition; and that the piston is not jammed.
					Also check that the oil pumps for the lube pressure and control pressure are in good condition.
					Oil leak in pressure circuit (damaged O-ring).
		1-2.	Main pressure is normal.	1-2.	Try to engage the clutch with the manual safety valve. If it works, remove the servo-valve from its seat and verify that the plunger and needle can move freely. Replace faulty parts if necessary.
					With prime mover stopped, remove the omega valve inspection cover on top of the main housing top cover and verify that the "omega piston" is not jammed in closed position.
					Also check that the four screws that secure the omega carrier, and two screws that secure the omega cover are properly tightened.
					If these checks do not solve the problem, it could be necessary to strip the unit from the rear end and check:
2-1.	Electrical or electronic failure.	2-1.	No current to servo-valve coil.	2-1.	Check continuity of wiring between servo-valve and electronic controller PX-10001.
					Check power supply and fuse (24 Vdc).
		2-2.	Low current to servo-valve.	2-2.	Check setpoint in relation to feedback signal. Refer to electronic controller display PX-10002 to facilitate troubleshooting.

Unstable MCD Output Speed

Table 9. Troubleshooting Chart

Symptom		Cause		Remedy	
1-1.	Mechanical or Hydraulic failure.	1-1.	Main pressure is unstable.	1-1.	Check oil level, and check oil pump suction lines for leaks. Verify that oil being used is to correct specification, and make sure it is not foaming. If the control pressure is also unstable, refer to "Electrical and electronic failure."
2-1.	Electrical or Electronic Failure	2-1.	Bad contact. Dry solder. Loose connection. External interference (disturbing control system)		Check the stability of the input speed and current through the "Run Time Data" screen on the electronic controller display PX-10002.
			2-2. Used (worn) servo-valve.	2-2.	Replace servo-valve.
			2-3. Fault on feedback pressure.	2-3.	Check the pressure converter signal and linearity.
			2-4. Gains of regulator are too high.	2-4.	Reduce them.

If you need help, contact

Product Service Department
Twin Disc, Incorporated,
Racine Wisconsin, USA.

Disassembly

Removal of Accessories

Remove Trailing Pump

1. Loosen coupling elbow on the suction tube at the pump level and at the body screen level. Remove the suction tube.
2. Loosen the coupling of the discharge tube at the pump level and at the three way valve level. Remove the discharge tube.
3. Loosen the four nuts that secure the group motor pump on its support; remove the group motor pump.
4. Remove the four screws that secure the group motor pump support on the input and output covers. Remove the covers.

Remove Protection Plate

1. Sufficiently loosen the two screws securing the protection plate bracket to the output end cover so that you can move the bracket far enough to free the plate. Remove the plate.
2. Remove the two screws completely, and remove the output end bracket.
3. Remove the two screws securing the input end bracket to the cover. Remove the input end bracket.

Remove the Gauge Panel and Junction Box

Note: The gauge panel may be mounted on either the valve side or the lube side of the unit, depending on the location of the MCD (port or starboard side).

1. Remove the connections from the main pressure, control pressure, and lube pressure gauges. Remove connections from the input ends of these copper tubes (on main valve panel).

Note: If the gauge panel is mounted on the lube side of the unit, the copper tubes can remain attached to the unit housing in the protective tube over the top of the unit.

2. Remove three temperature probes: input bearings, output bearings, lube oil outlet.
3. Remove gauge panel and junction box:

A. Valve Side Gauge Panel

- a. Remove two screws securing the gauge panel to the valve side cover plate.
- b. Remove connections to filter indicator, servo-valve, input and output speed pick-ups, control pressure transmitter and any other electrical accessories that may prevent removal of junction box.
- c. Loosen four screws that secure the gauge panel to the lube pressure valve top cover, and pull gauge panel and junction box from the unit.

B. Lube Side Gauge Panel

Note: The junction box in this configuration is attached to a bracket on the valve side of the unit and can be removed independently of the gauge panel.

- a. Remove three screws that secure the gauge panel to the lube oil side cover.
- b. Remove two socket head capscrews that secure the top of the valve panel to the main housing.
- c. Remove the gauge panel.

Removal of Flanges

Remove the Output Flange

1. Remove the locknut and the lockwasher, and the washer from the output shaft.
2. Replace the locknut until it is 5 mm (0.2") from the flange face to act as a safety stop.



Figure 36. Locknut and Injector

3. Free the output flange from the shaft with hydraulic pump and injector: Connect the oil pressure system (See Special Tools) to the 3/8-19 BSP thread in shaft, and apply pressure. Pressure of 25000 psi may be required to remove the flange. If necessary, heat the outside diameter of the flange rapidly to expand it and facilitate removal.

⚠ WARNING

Handle heated parts with care!



Figure 37. Heat Flange if Necessary Before Removing

4. With a lifting device, remove the flange from the shaft.



Figure 38. Remove Flange

5. Output flange removed.



Figure 39. Output Flange Removed

Remove the Input Flange

Follow the same procedure to remove the input flange.

Removal of Side Panels

Before any major disassembly or inspection of the clutch can be carried out, you must remove the two side panels: the valve block panel (main pressure and lubrication pressure), and the lubrication oil pump panel.

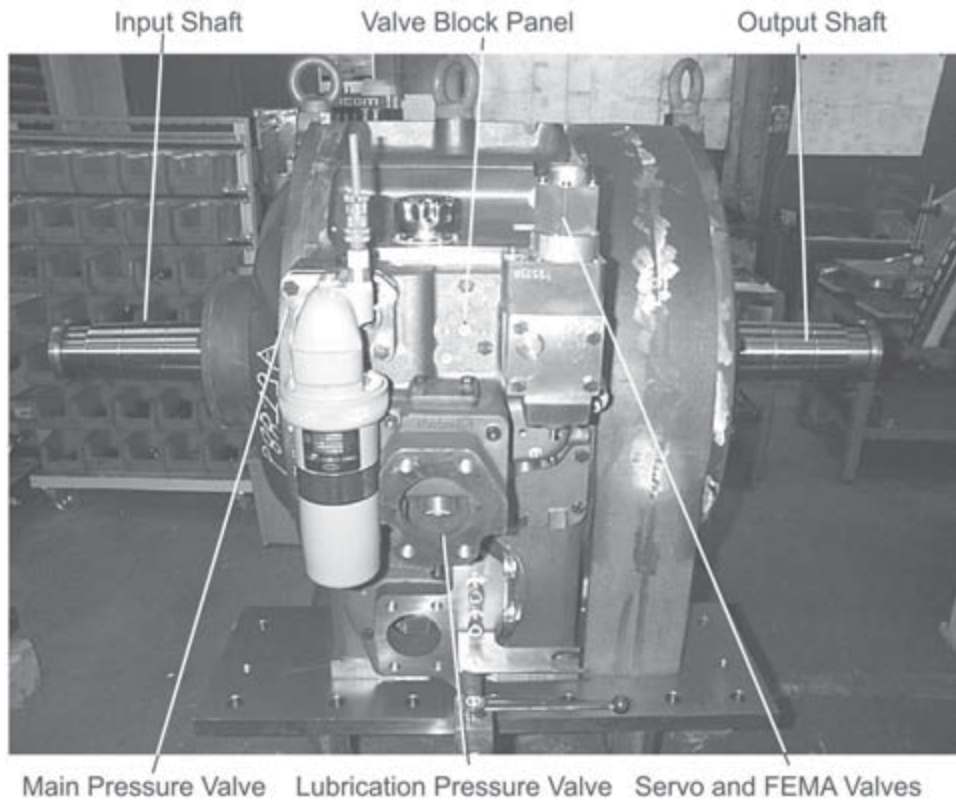


Figure 40. View of MCD, Valve Block Panel Side

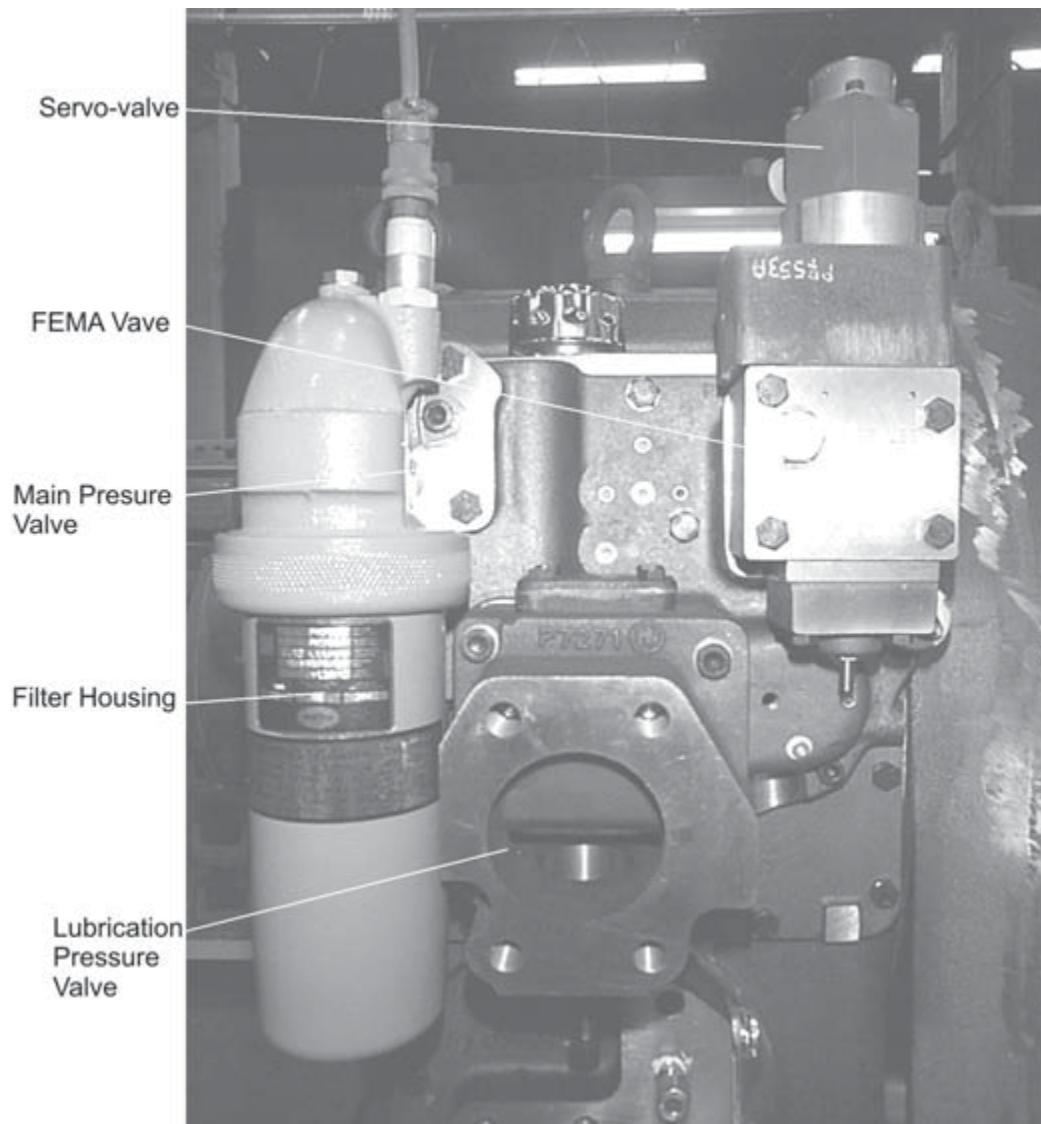


Figure 41. Valve Block Panels

Remove Filter Group; Disassemble Main Pressure Valve

1. Remove the electrical connection from the clogged filter detector.
2. Remove the filter assembly by removing two M10 - 1.5 x 35 socket head capscrews.
3. Remove the spacer plate by removing the four M10 - 1.5 x 35 hex head capscrews.
4. With the spacer plate removed, you have access to three M10 - 1.5 x 90 socket head capscrews sunk into the main valve block.
5. Remove the valve block hydraulic supply hose (main pressure pump discharge).
6. Unscrew the bottom retainer spring; discard O-ring and sealing washer.
7. Remove the spring, tube spacer and piston.

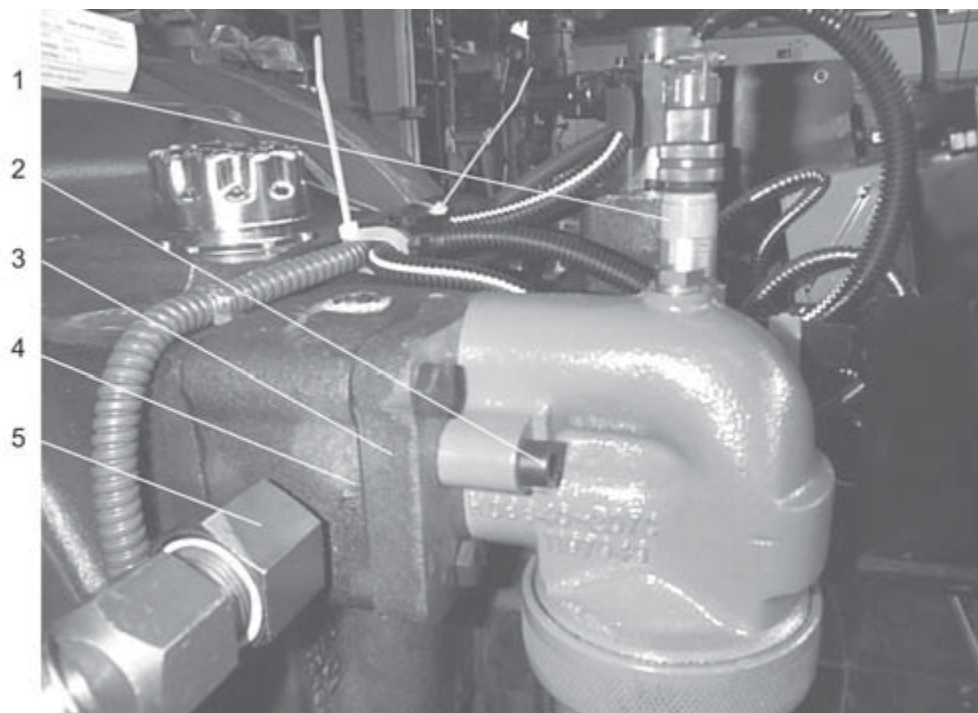


Figure 42. Filter Group

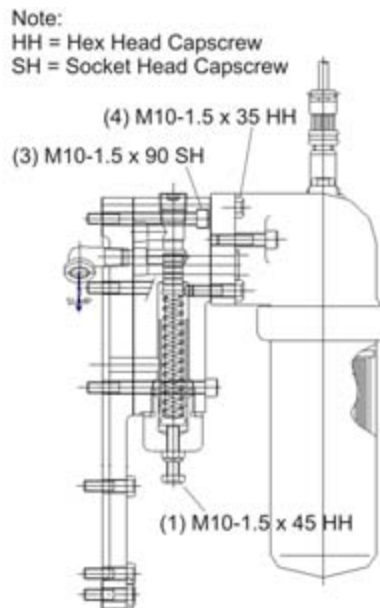


Figure 43. Main Pressure Valve and Filter Assembly

Note: Unless necessary, do not alter the position of the pressure adjustment screws on the bottom of the modulating valve, the lube valve, or the main pressure valve. If the position must be altered, measure the distance between the end of the screw and the face of the bottom adapter, and record this measurement so you can reset the screw when reassembled.

Remove and Disassemble Modulating Valve Assembly

1. Loosen the screw on the face of the electrical connector, and remove the connector.

Remove four 3/8" - 16 UNC x 3 1/2" hex head capscrews, that retain the electrical modulating valve assembly to the adapter plate, and discard the gasket.

2. Remove four M8 -1.25 x 22 sunken socket head capscrews that secure the adapter plate to the cover, and discard the gasket.
3. With the spacer plate removed, remove one M10 -1.5 x 65 socket head capscrew in the main valve block.

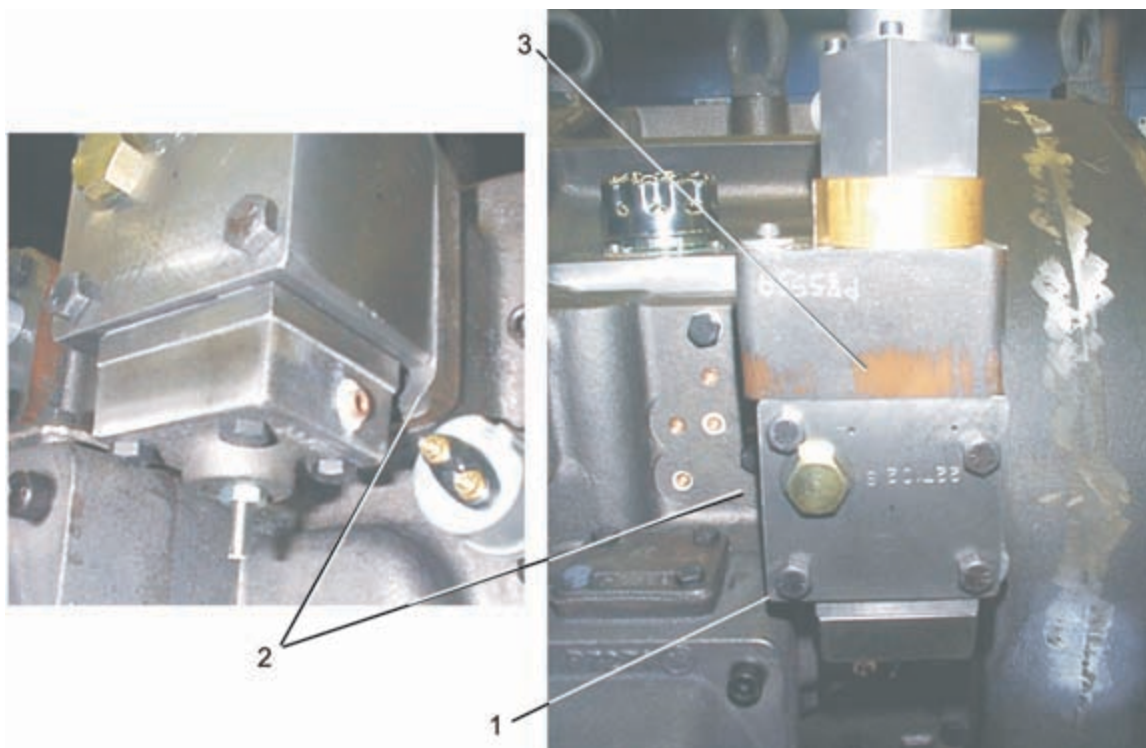


Figure 44. Modulating Valve Assembly

4. Remove the four M4 socket head capscrews securing the servo-valve on its support and discard the O-ring.
5. Remove the four M5 x 25 socket head capscrews, and separate the servo valve support from the adapter valve. Discard the gasket.

6. Remove the four sunken 5/16 - 18 x 2.25 socket head capscrews, and separate the adapter valve from the valve body. Discard the gasket.
7. Remove the 5/16 - 18 x 2 socket head capscrews and separate the cover adjusting screw from the valve body and plate space. Discard the gasket.
8. Remove the piston, spring, and spring seat from the valve bore.

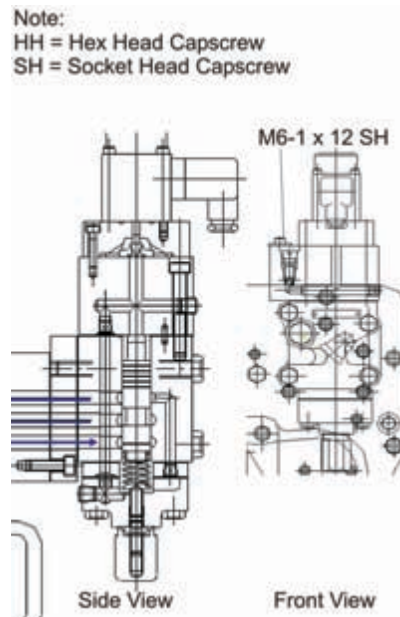


Figure 45. Modulating Valve

Remove and Disassemble Lubrication Valve Block

1. Remove lubrication pressure valve block by removing three M10 - 1.5 x 160, and one M10 - 1.5 x 140 socket head capscrews. Remove the valve body and discard the gasket

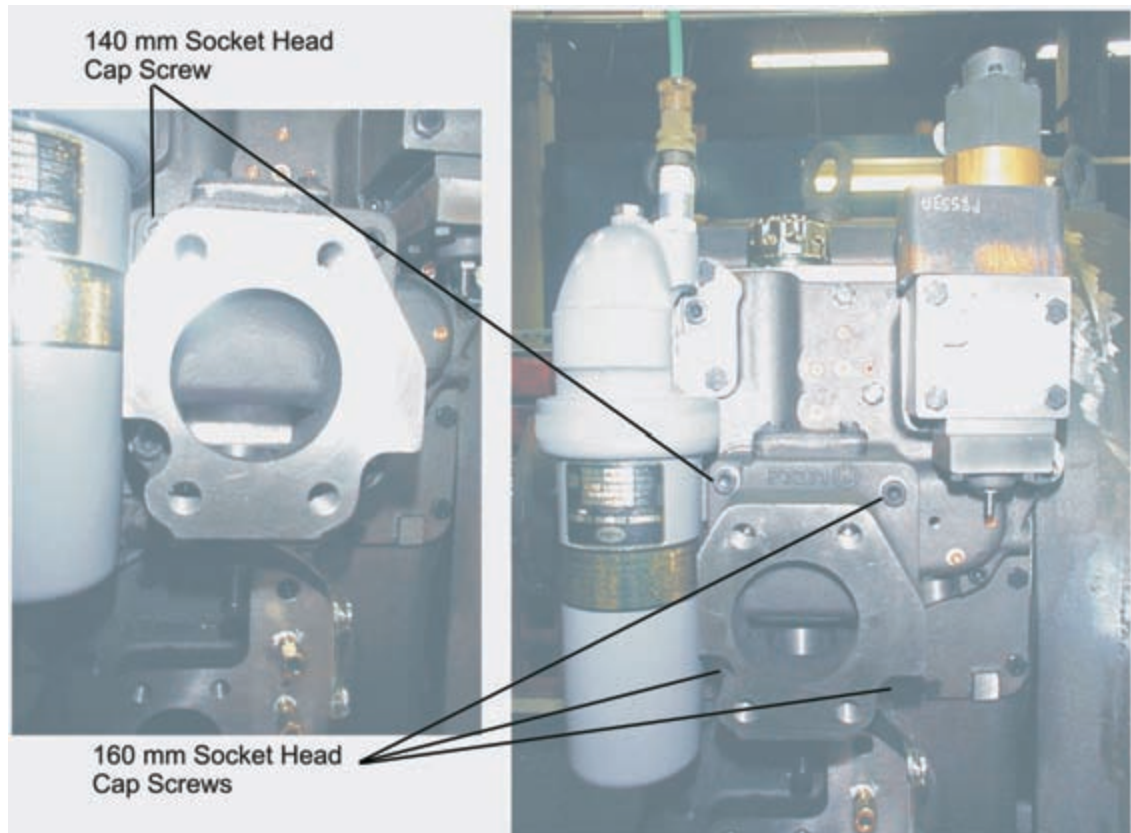


Figure 46. Lubrication Pressure Valve Block

2. Remove three M8-1.25 x 25 hex head capscrews that secure the bottom cover to the valve body.
3. Remove the retainer spring, O-ring, spring and piston.
4. Remove four M8-1.25 x 30 capscrews that secure the cover on the body, and discard the gasket.
5. Push the pin through the bore.

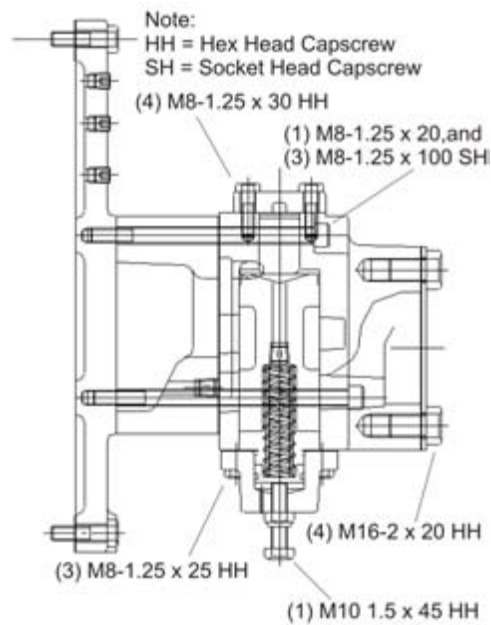


Figure 47. Lubrication Valve

Remove and Disassemble the Main Pressure Valve Block Assembly

1. Remove the outer mounting plate and the inner mounting plate by removing nine M10 -1.5 hex head capscrews: (7) 35 mm, (1) 65 mm, and (1) 40 mm; and six M10 -1.5 socket head capscrews: (3) 90 mm, (2) 65 mm, and (1) 55 mm.
2. Removal of these plates allows access to two hydraulic jumper tubes: control pressure and lubrication pressure.

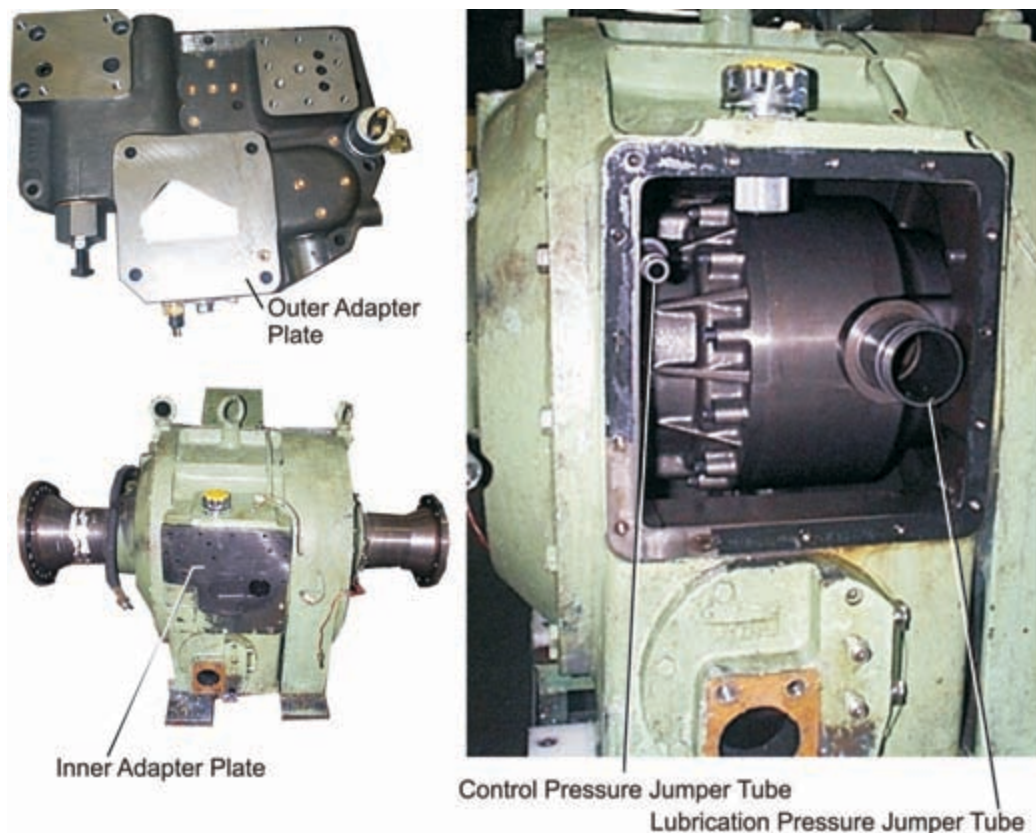


Figure 48. Main Pressure Valve Block Assembly Removed

Remove Internal Hydraulic Tubes

1. Clutch housing
2. Remove two M10 - 1.5 x 35 socket head capscrews; then remove two hydraulic jumper tubes.
3. Pull out the lubrication outlet jumper tube.
4. Location of omega valve.

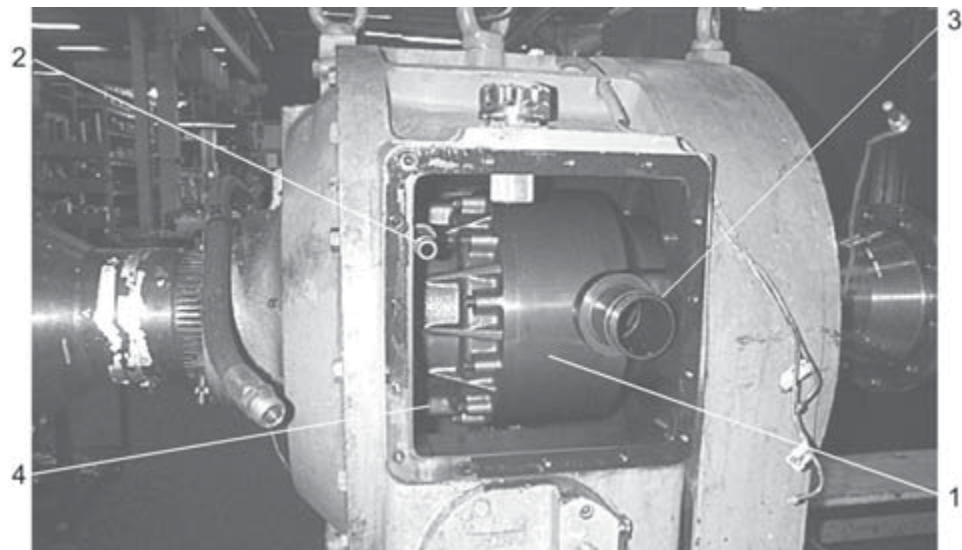
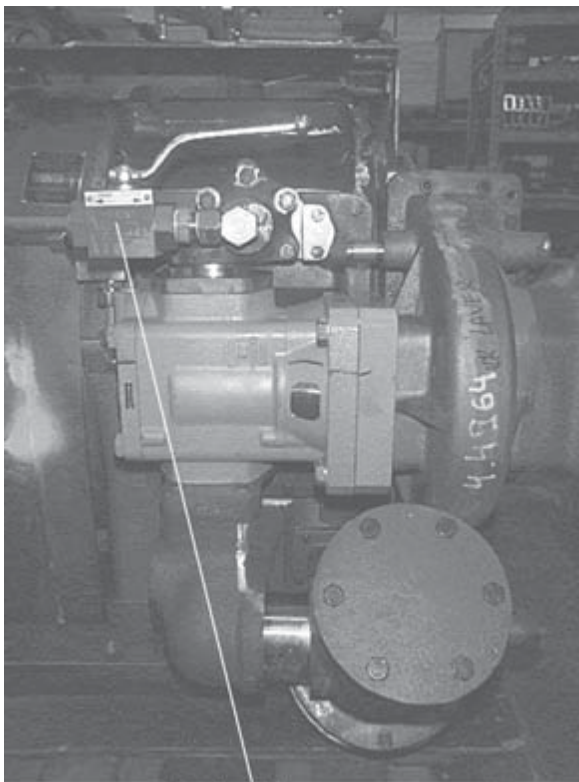
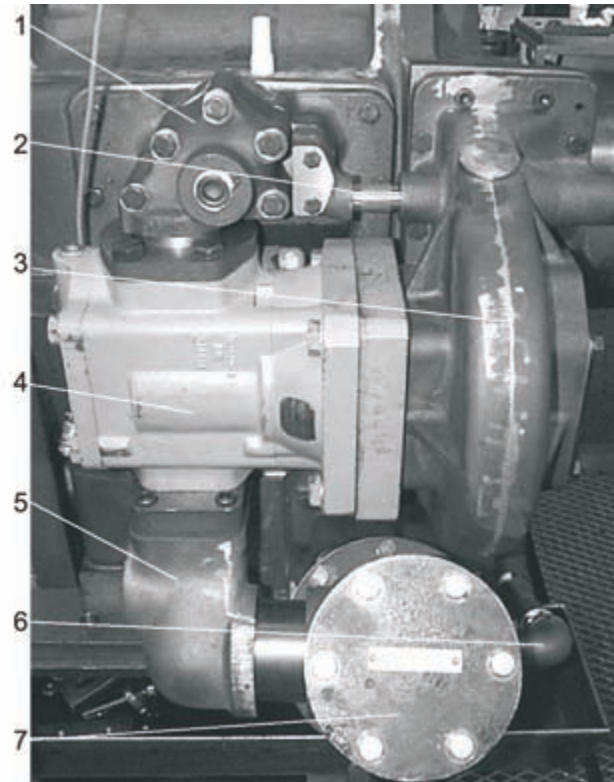


Figure 49. Adapter Plate Removed



Drain Valve



1. Hydraulic manifold, lubrication outlet to clutch
2. Hydraulic manifold, PTO bearing lubrication
3. PTO gear housing
4. Lubrication pump
5. Lubrication oil inlet manifold
6. Main pressure oil inlet manifold
7. Suction strainer housing

Figure 50. Lubrication Oil Pump

Remove Lubrication Oil Outlet Manifolds

1. Remove M10 - 1.5 socket head capscrews: (2) 150 mm, (2) 70 mm, and (1) 100 mm; then remove the outlet manifold.
2. Remove the spacer, if applicable.
3. Remove the jumper cable.
4. Remove two M8 - 1.25 x 70 hex head capscrews, then remove the bearing lubrication manifold.
5. Remove the jumper tube.

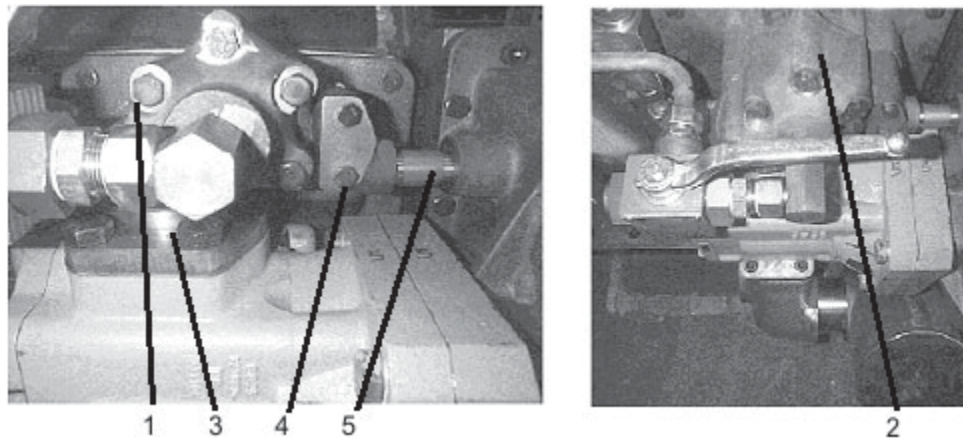


Figure 51. Outlet Manifolds

Remove the Lubricating Oil Pump

1. Remove four M16 - 2 x 50 hex head capscrews; with a lifting device, pull the pump and manifold from the suction strainer.
2. Remove the pump drive adapter.
3. Remove the suction manifold.

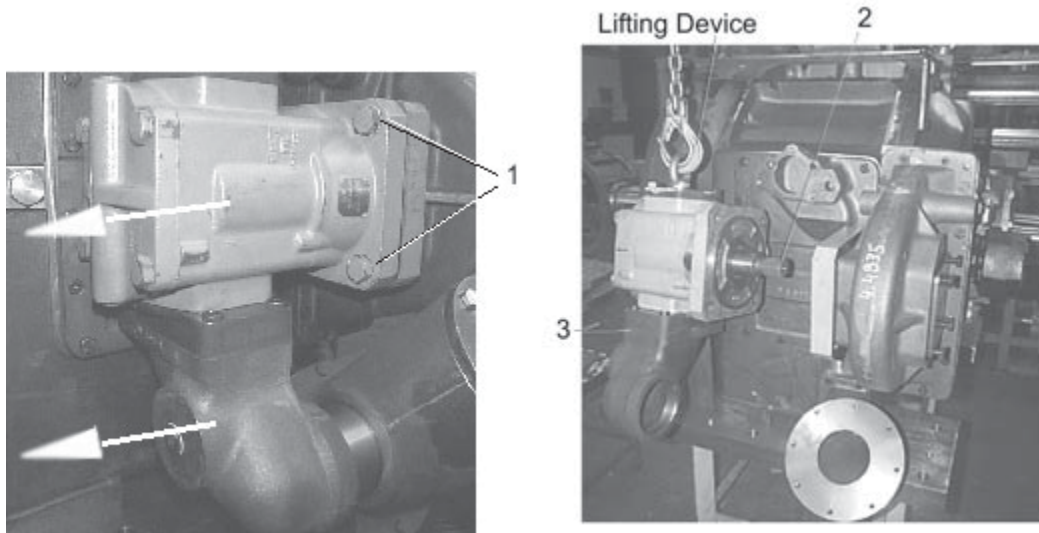
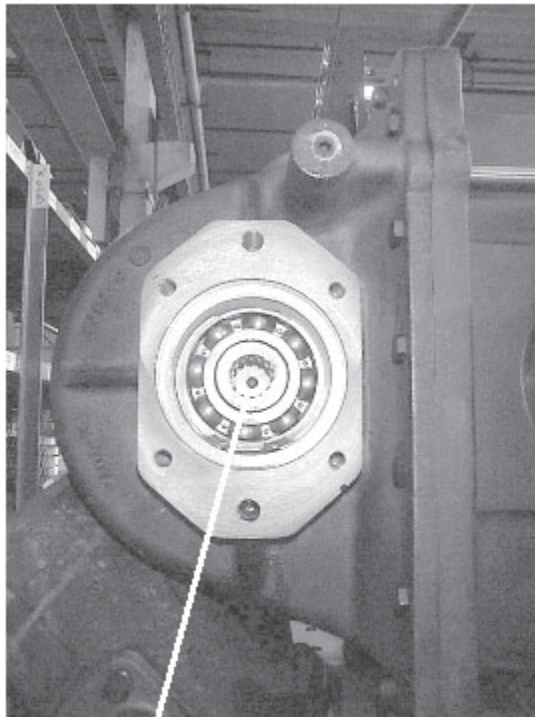


Figure 52. Lubricating Oil Pump

Remove PTO Housing

1. Remove the PTO mounted hydraulic pump, if necessary
2. Remove (13) M10 - 1.5 x 30 hex head capscrews, and one M10 - 1.5 x 25 hex head capscrew.
3. With a lifting device, remove the PTO housing from the main housing.



Remove PTO mounted hydraulic pump, if necessary



Figure 53. PTO Assembly

Disassemble Lube Oil Pump and PTO Drive

1. If necessary, remove the cover plate of the PTO secured by four M12 - 1.75 25 screws.
2. Remove the snap rings from either side of the bearings.
3. Place the PTO drive under a suitable press and press the shaft from the bearings, gear and spacers.
4. Remove the bearings, gear and spacers.

Remove the Main Pressure Pump

1. Detach the discharge and suction hydraulic hoses from the pump.
2. Remove four M10 - 1.5 x 25 socket head capscrews, and remove the pump. Then remove six M10 - 1.5 x 30 socket head capscrews, and remove the pump spacer from the housing.



Figure 54. Detach Hoses; Remove Pump and Spacer

Remove PTO Intermediate Gear

1. Insert a steel bar through the splined hole in the drive shaft to push against the rear of the front housing.
2. Using the two tapped holes in the drive shaft, attach a plate to the end of the drive shaft. The plate must have a tapped hole in the center.
3. Turn the screw through the plate and against the push bar, pulling the shaft from the gear, bearings, and spacers.

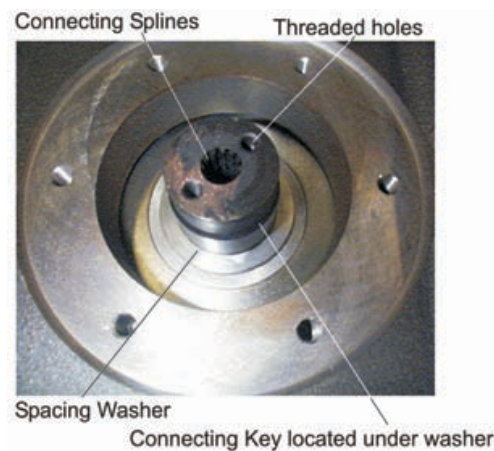
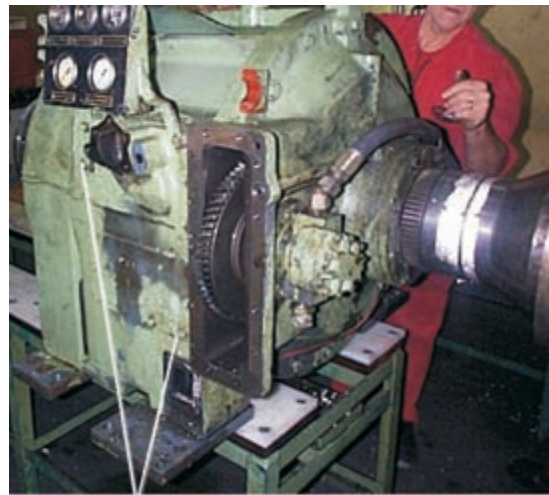


Figure 55. Intermediate Gear Shaft Assembly

4. Remove the gear, spacers and baffle plate from the housing.

Remove Pump Adapter Plate

1. Remove (14) M10 - 1.5 x 35 hex head capscrews and remove the pump adapter plate.
2. Pull out the oil jumper tube.



M10 - 1.5 x 35 Hex Head Cap Screws



Lubricating Oil Jumper Tube
Removed

Figure 56. Side Panel

Removal of Output End Cover and Associated Parts

Remove Output Seal Carrier

1. Remove the output seal carrier by removing the M16 - 2 hex head capscrews: (5) 160 mm, (1) 150 mm, and (1) 170 mm.
2. Remove the output speed pickup bracket.
3. Take care with the bearing clearance adjusting shims so you can use them as a guide during reassembly with new shims.

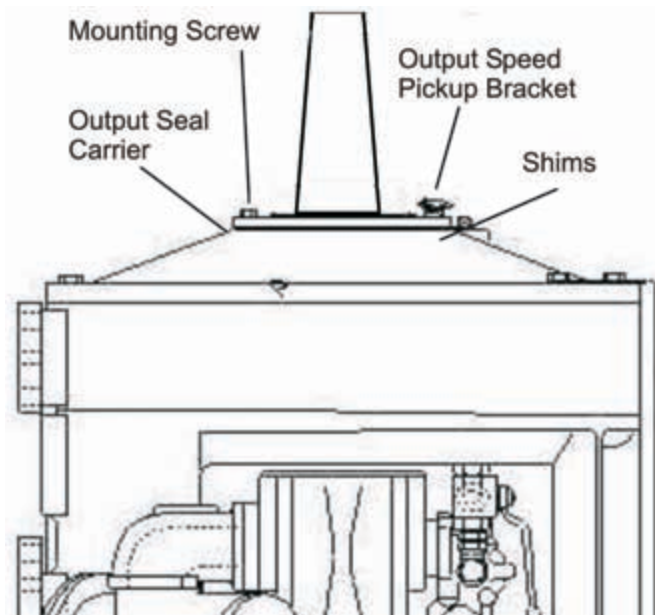


Figure 57. Output Seal Carrier

Remove the Output End Cover and Output Shaft Assembly

1. Before removing the cover, place a 2-3 mm (0.079" - 0.118") shim under the piston carrier, and detach the carrier from the clutch housing by removing (12) M12 - 1.75 x 18 socket head capscrews.
2. Remove the hydraulic manifold by removing (4) M10 - 1.5 x 35 hex head capscrews.

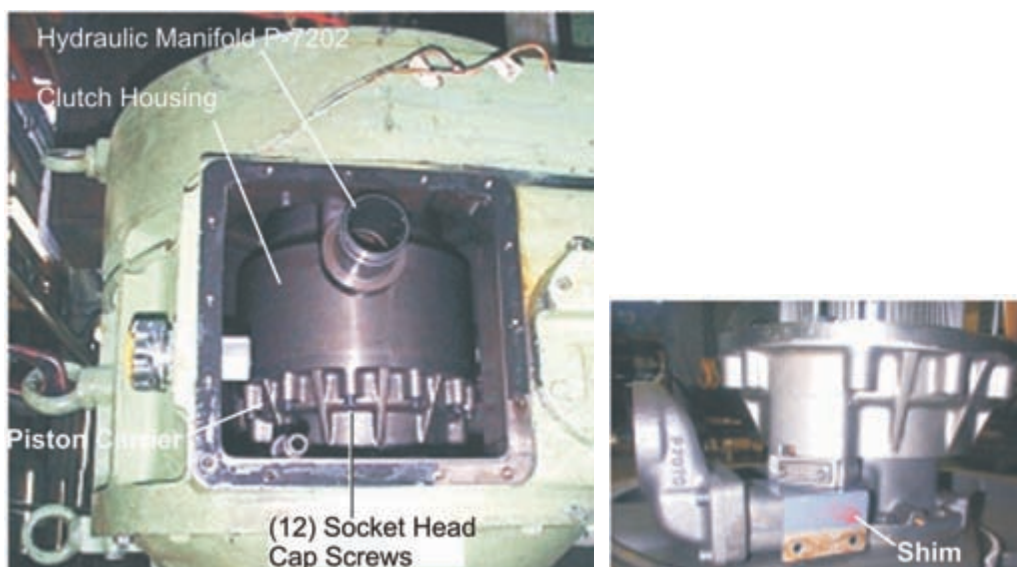


Figure 58. Shim Under Piston Carrier

3. Remove the output bearing temperature pickup from the output end cover.

Check that nothing is left attached to the end cover or to the internal assembly that could interfere with the output assembly being lifted from the unit.

4. Remove the M16 - 2 hex head capscrews that secure the cover: (13) 55 mm, (2) 220 mm, and (1) 240 mm.

5. With a lifting device, remove the output assembly from the unit.
6. Remove the housing extension

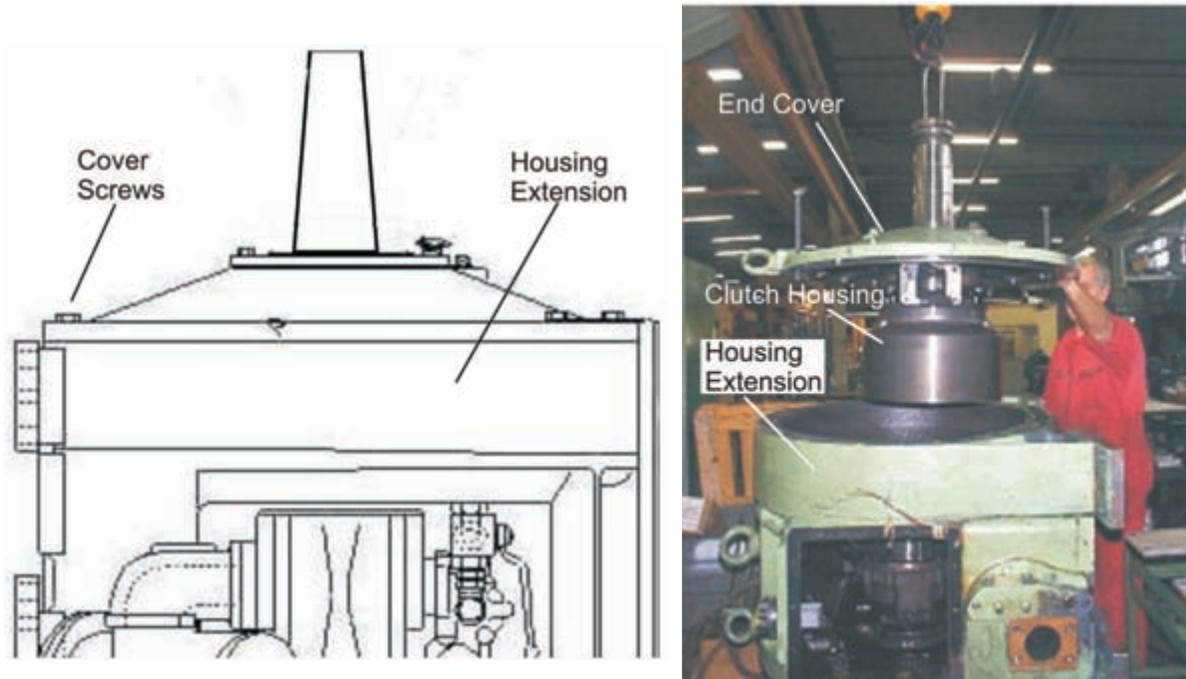


Figure 59. Remove Output Assembly

7. Place the output assembly on a platform and remove the end cover by lifting it from the shaft.



Figure 60. Remove the End Cover

Removal of Output Bearings

Preparation

1. Screw six M-16 threaded rods, 800 mm (31.5") long, into the seal carrier holes of the hydraulic manifold (lube oil outlet; here used as bearing puller).
2. Place an appropriate puller plate (see Special Tools), and hydraulic jack on the end of the output shaft.

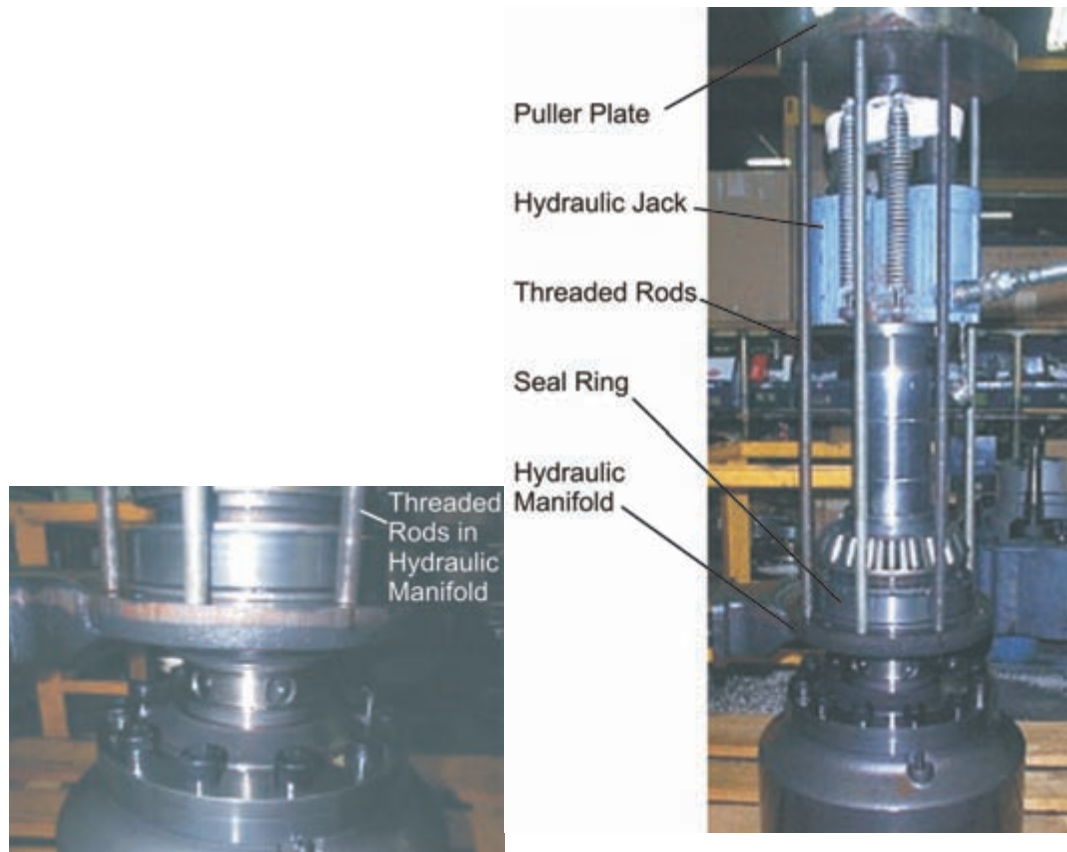


Figure 61. Bearing Puller

3. Heat bearings to expand them and facilitate removal.

⚠ WARNING

Handle heated parts with care!



Figure 62. Heat Bearings

4. Remove both output bearings and seal ring at the same time. Attach a lifting device to the puller plate to ensure the stability of setup when bearings come free of shaft.



Figure 63. Attach Lifting Device for Stability; Remove Bearings

5. Remove two piston rings.

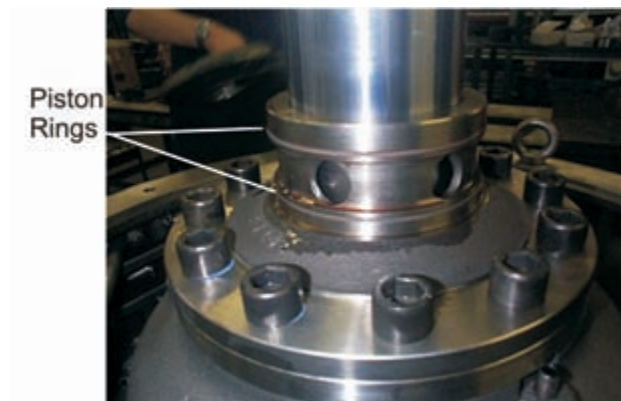


Figure 64. Piston Ring

Disassembly of Output Shaft from Clutch Housing

1. Remove (12) M20 - 2.5 x 30 socket head capscrews.



Figure 65. Output Shaft

2. Remove the oil cover.



Figure 66. Removing Oil Cover

3. Match the output shaft and clutch housing, and lift the shaft from the housing with a lifting device.

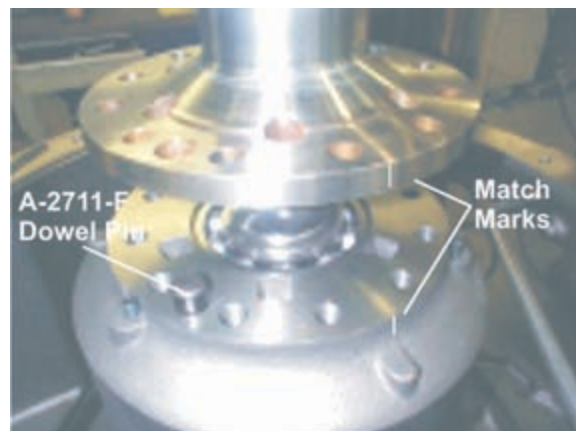


Figure 67. Lift Shaft from Housing

Removal of Main Housing

1. Remove the (16) M16 - 2 hex head capscrews securing main housing and input cover: (12) 55 mm, (2) 60 mm (1) 50 mm and (1) 80 mm.
2. Lift the main housing with a lifting device.



Cover Secured with (16)
Hex Head Cap Screws

Figure 68. Remove Main Housing

Disassembly of Clutch Interior

Remove Clutch Plates and Accessories

1. Remove upper part of the clutch to allow access to internal clutch assembly: friction plates, steel plates, belleville washers, spacer washers, hub, belleville washer guide pins, pilot bearing.

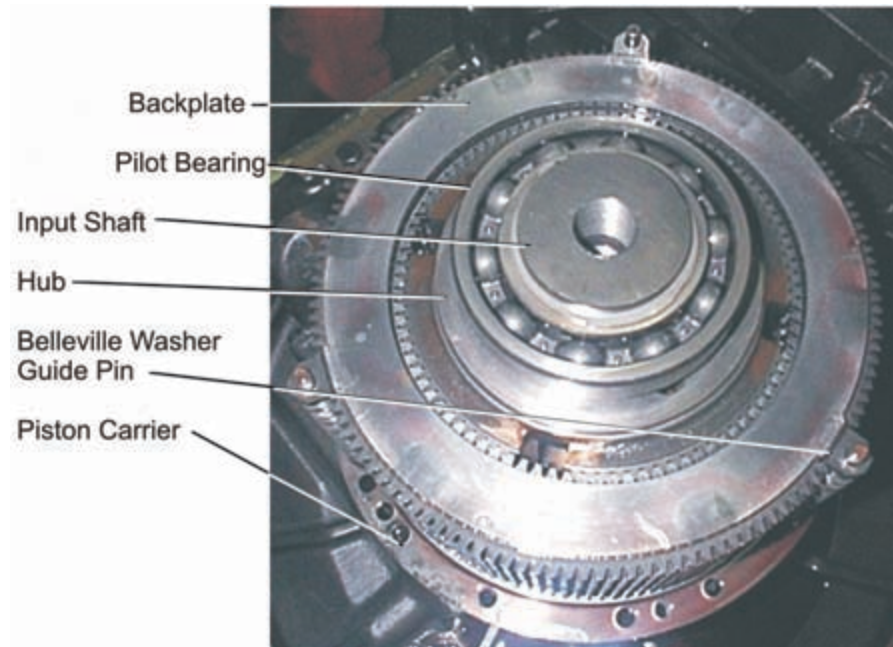


Figure 69. Clutch

2. Remove the backplate.
3. One by one, remove the friction plates, belleville washers, spacer washers and steel plates.

Remove Pilot Bearing

1. Remove the snap ring, and the spacer washer.
2. Pull the pilot bearing with a bearing puller.

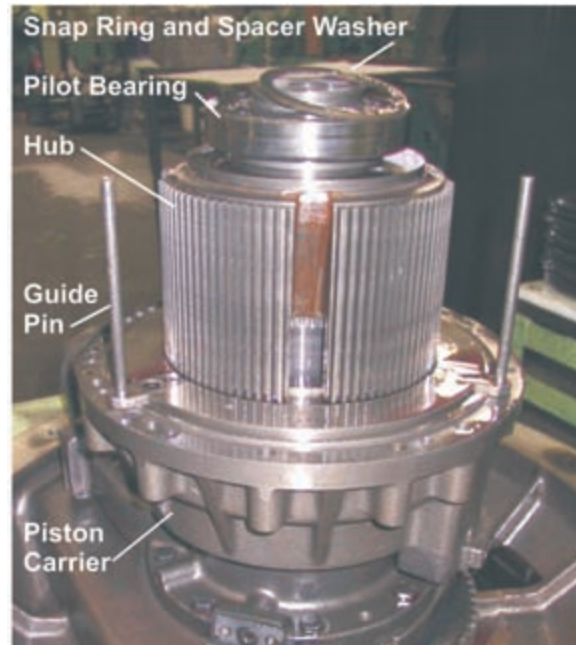


Figure 70. Remove Pilot Bearing

Remove Clutch Hub

1. Attach hydraulic jack, threaded rods and pulling bar.
2. Set the jack and oil pump.
3. If necessary, heat the hub to facilitate removal.

⚠ WARNING

Be careful when handling heated parts!

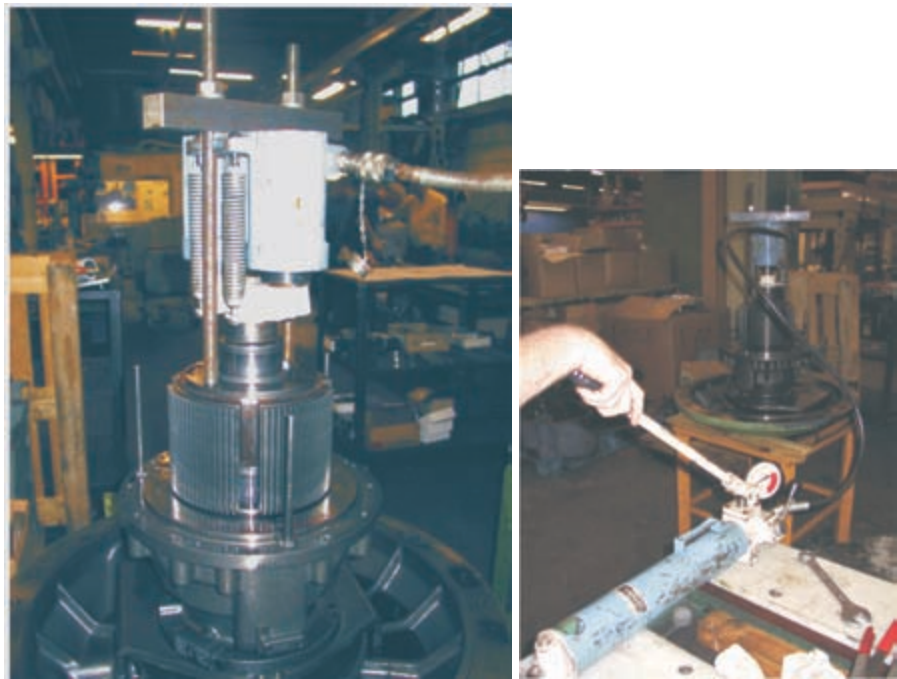


Figure 71. Removing Clutch Hub

Disassemble Piston Carrier

Remove the clutch piston assembly: Install two threaded rods in the holes provided, and lift out the piston. Remove the Teflon® rings and the O-rings from the inner and outer grooves.



Figure 72. Clutch Piston Assembly

With an overhead crane, carefully lift the assembly in order not to damage or break the piston rings.

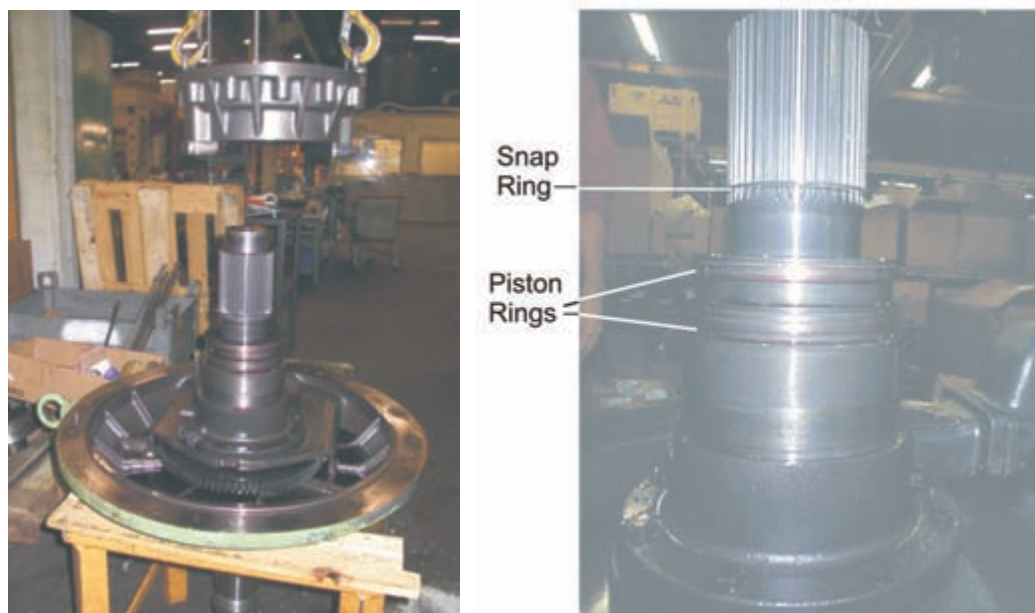


Figure 73. Removing Piston Carrier

Disassemble the Lube Oil Collector

1. Remove the snap ring from the splined shaft.
2. Remove the hydraulic collector by first removing eight M12 - 1.75 x 35 hex head capscrews.



Figure 74. Remove Snap Ring and Screws

3. Carefully remove the collector in order not to damage or break the piston ring on the race.

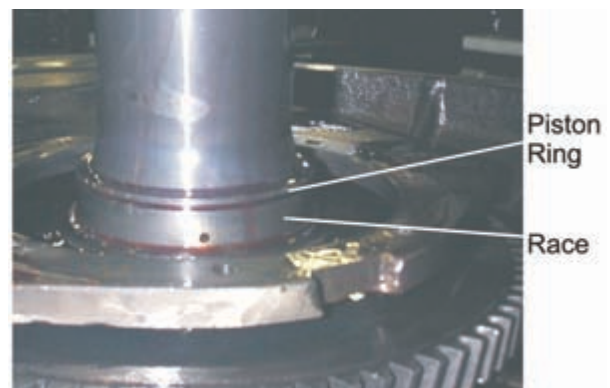


Figure 75. Remove Collector

Disassemble the Input Shaft

1. With an overhead crane, place the input shaft assembly on a solid platform support.



Figure 76. Place Shaft on Solid Platform

2. Remove the dog screw.
3. Remove the carrier seal.

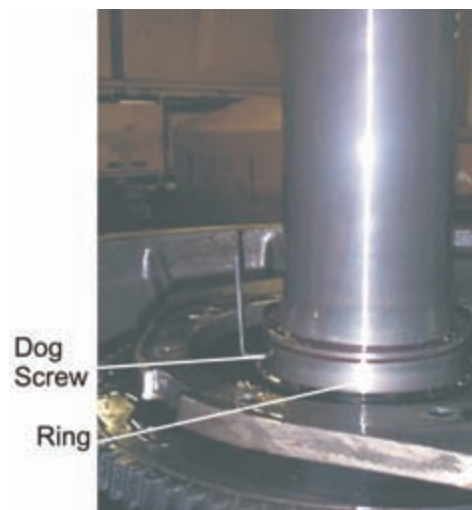


Figure 77. Ring and Dog Screw; Carrier Seal

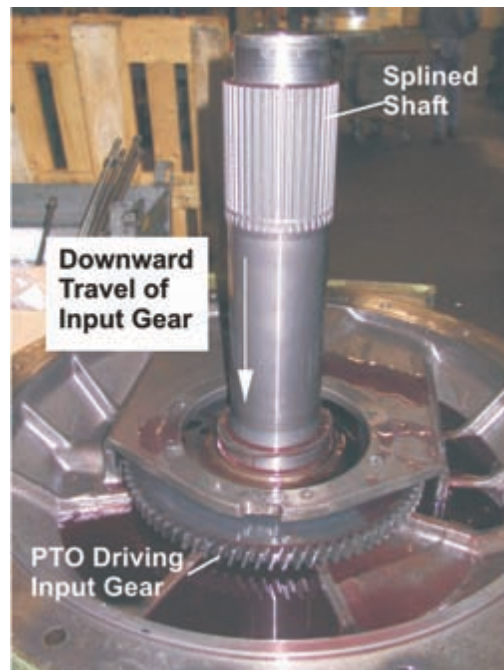


Figure 78. Input Shaft

4. With a gas torch, heat the PTO gear to 110°C.

⚠ WARNING

Handle heated parts with care!

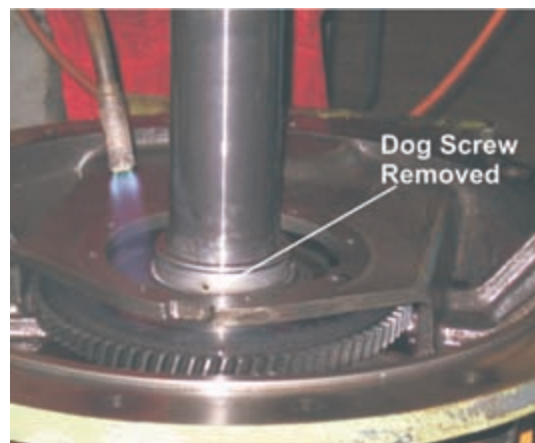


Figure 79. Heat PTO Gear

5. While heating the gear, hit the top of the shaft with a copper hammer.



Figure 80. Removing Input Shaft

6. Dampen the shaft motion with piece of wood.



Figure 81. Protect Shaft with Wood Block

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings piston rings, seal rings, snap rings, etc., as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

- ☐ Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must be dried and oiled immediately to prevent corrosion.
- ☐ Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.
- ☐ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ☐ Use clean solvent to flush oil pumps, valves, etc.
- ☐ Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.
- ☐ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

DO NOT remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

CAUTION

Never dry bearings with compressed air. Do not spin unlubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

- ☐ For previously sealed joints, scrape surfaces to remove old gasket material or Loctite® sealant.
- ☐ Clean surfaces with solvent to remove oil and grease residue.
- ☐ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ☐ Replace cast parts or housings that are cracked.
- ☐ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding or grinding. This will cause loss of fit of bearings or races.
- ☐ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ☐ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ☐ Inspect ground tapers for scratches, galling or scoring damage. If any of these are present, replace the part.
- ☐ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ☐ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ☐ Inspect studs for damaged threads and looseness. Replace defective studs.
- ☐ Inspect dowel pins for wear or damage. Replace defective dowels.
- ☐ Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings

- ☐ Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.
- ☐ Inspect bearings for corrosion, and for indication of wear of balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. If you find one of these defects, replace the bearing.
- ☐ Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust Washers and Spacers

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears

- ☐ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ☐ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ☐ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found. Refer to wear limits in Description and Specifications.

NOTES

Assembly

Assembly of Input Shaft and PTO Gear

Position the input shaft

Note: The input cover must be positioned horizontally on a support form.

1. Use two pieces of flat steel to support the gear as you insert it into the cover. Heat the gear to 110°C (230°F). Align the bore with the input shaft opening.

⚠ WARNING

Handle frozen and heated bearing parts with care!

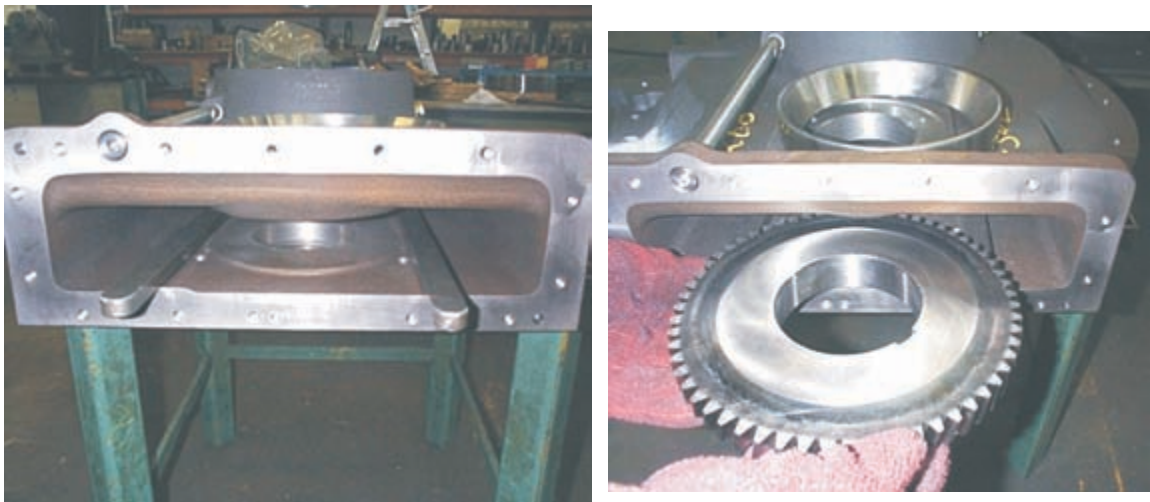


Figure 82. Input Cover and PTO Gear

2. Using a hoist, position the input shaft above the gear. Be sure the key is aligned with the keyway



Figure 83. Aligning Shaft with Gear

3. Carefully lower the input shaft into the gear bore. It may be necessary to slightly move the shaft to ease the assembly.



Figure 84. Lowering the Shaft; Shaft Located in Gear

4. Verify the gear and shaft are correctly assembled.

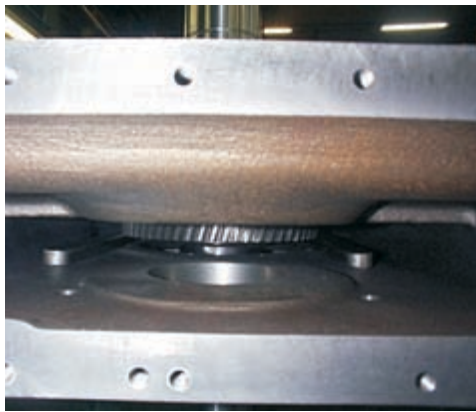


Figure 85. Inspect for Correct Positioning of Gear

5. Lift the shaft and gear until the gear contacts the housing. Block the shaft in this position.

Assemble Input Bearing

1. Place inside race (not preheated) in the housing. Preheat the bearings to 100°C to 110° C (212°F to 230°F).

⚠ WARNING

Handle frozen and heated bearing parts with care!

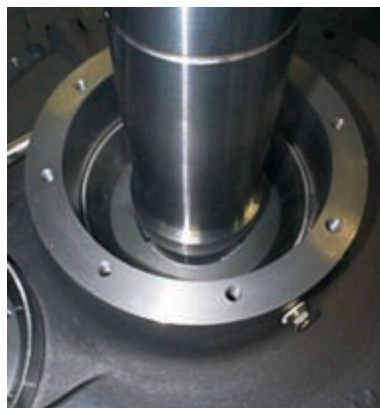


Figure 86. Input Bearings

2. Position the first bearing; then position the second bearing.

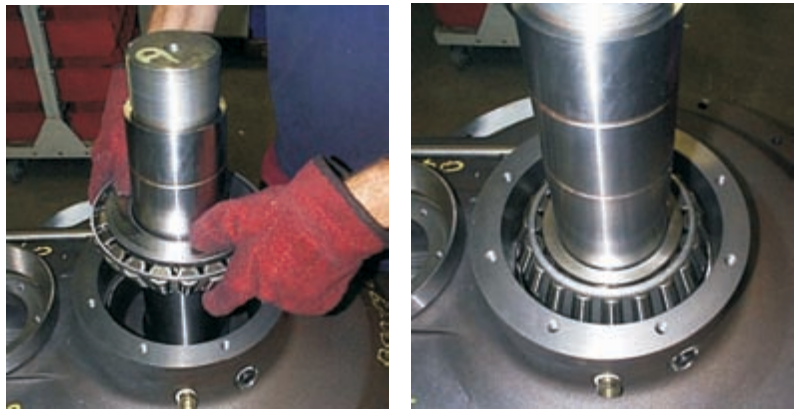


Figure 87. Positioning Bearings

3. Place the upper ring “cold.” Then place the sealing race, heated to 110 °C (230°F). Lightly coat the bore of the race with Loctite® 603.



Figure 88. Positioning Upper Race and Sealing Race

Set Bearing End Clearance

Note: Before setting bearing end clearance, allow bearings to cool after installation. Then, unblock the input shaft to allow it to drop so the lower (first) bearing inner race is in contact with the outer race. Turn the shaft a few times to ensure that the bearing is correctly seated.

1. Ensure that the upper bearing outer race is in contact with the upper bearing inner race.
2. Place the seal retainer in position on the input cover so that the pilot is resting on the bearing outer race.

Note: Do not install the oil seal into the retainer at this time.

3. Install the retainer screws and hand tighten. Do not overtighten the screws as this may deform the retainer leading to false measurement.
4. Using feeler gauges, measure the gap between the retainer and the input cover
5. Assemble a set of shims approximately 0.254 mm (0.010") thicker than the gap between the retainer and the input cover (as measured in the preceding step). Install the shims between the retainer and the input cover. Install the retaining screws and tighten them to 78 Nm (56 ft-lb).



Figure 89. Shims

6. Turn the shaft a few times to ensure it is correctly seated. Install a dial indicator with its finger on the end of the shaft. Lift the shaft and record the movement.

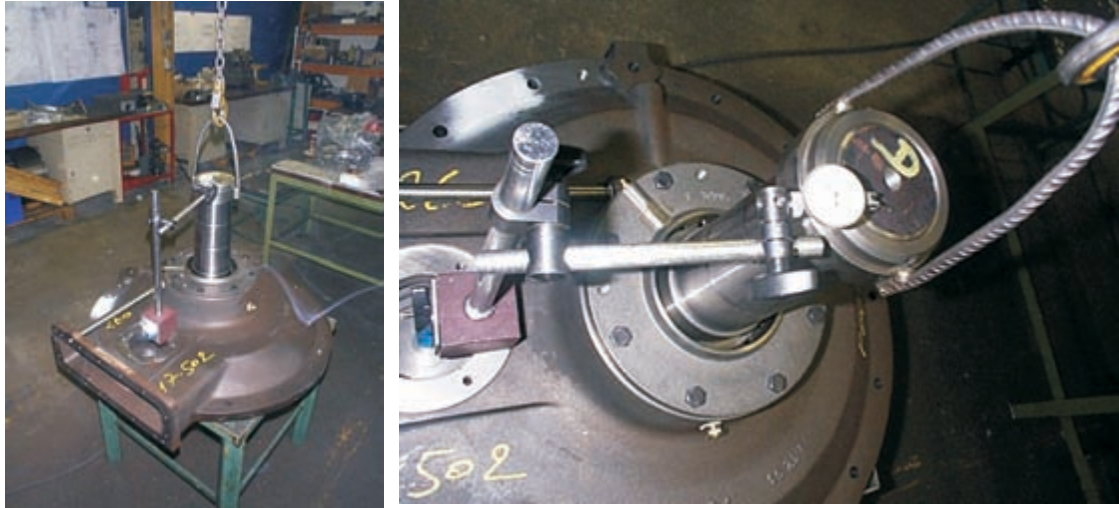


Figure 90. Dial Indicator Installed

7. Lower the shaft and remove the retainer and set of shims.
8. Measure the thickness of the shim pack, and calculate the thickness required to obtain total end play (clearance) of 0.038 mm to 0.127 mm (0.0015 to 0.0050").

Note: Adding shims will create movement; removing shims will reduce movement.

9. Place a thin film of Loctite® 574 sealant around the outside diameter of the seal. Install new oil seals into the retainer. Respect the orientation of the seals -- see drawing PX-8900, sheet 1.
10. Place a thin film of Loctite® 574 sealant between all the faces of the shims; then install the shim pack.
11. Install the seal retainer and mounting screws. Tighten the screws to 78 Nm (56 ft-lb).
12. Recheck to verify correct clearance.

Assemble the PTO Intermediate Gear

1. Install the first bearing -- not heated.

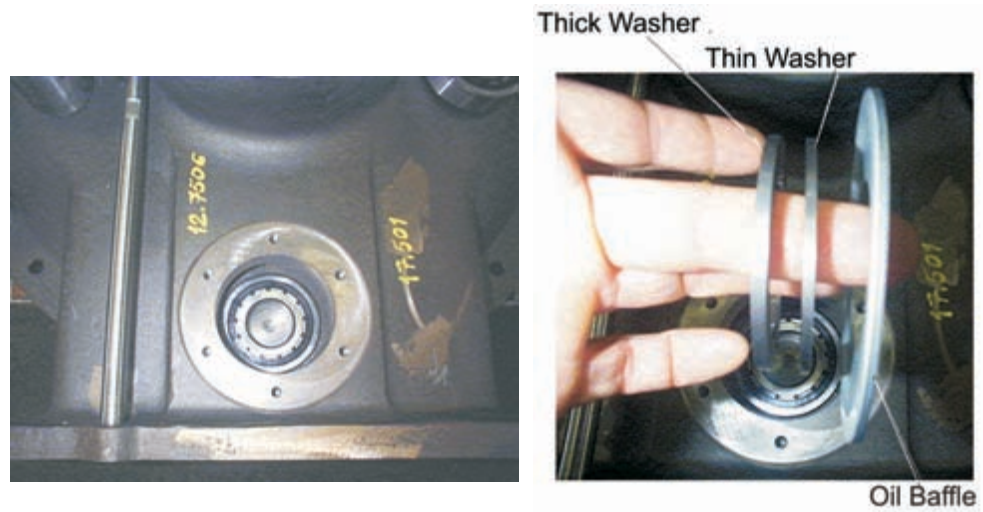


Figure 91. Bearing; Washers and Oil Baffle

2. Place the oil baffle with concave side toward the bearing.

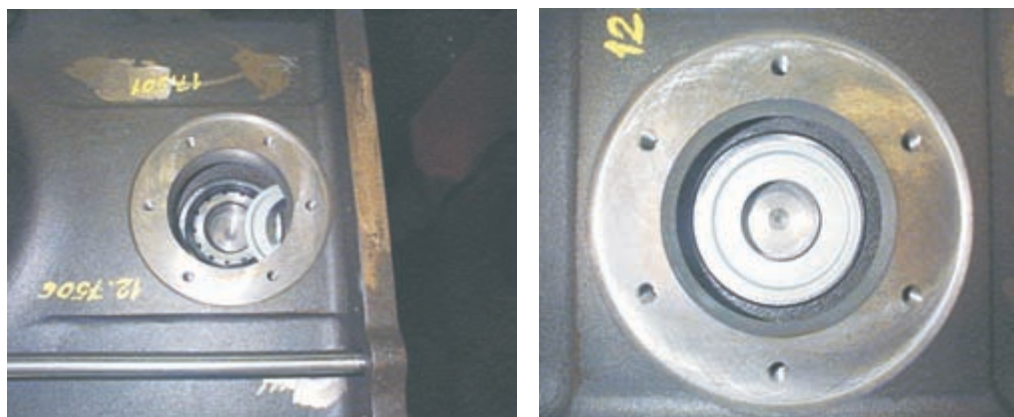


Figure 92. Positioning the Oil Baffle

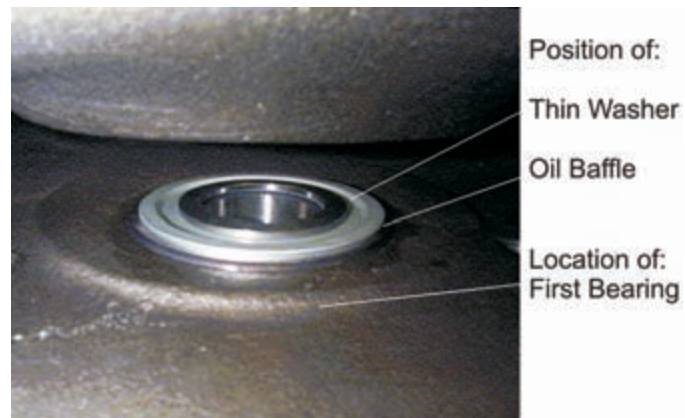


Figure 93. Oil Baffle Installed

3. Heat the PTO intermediate gear to 110°C (230°F) to allow assembly of the shaft which will drive the pump for the main pressure.

⚠ WARNING

Handle heated parts with care!



Figure 94. Pre-heat the PTO Gear

4. Carefully slide the PTO gear into place without disturbing the washer below.

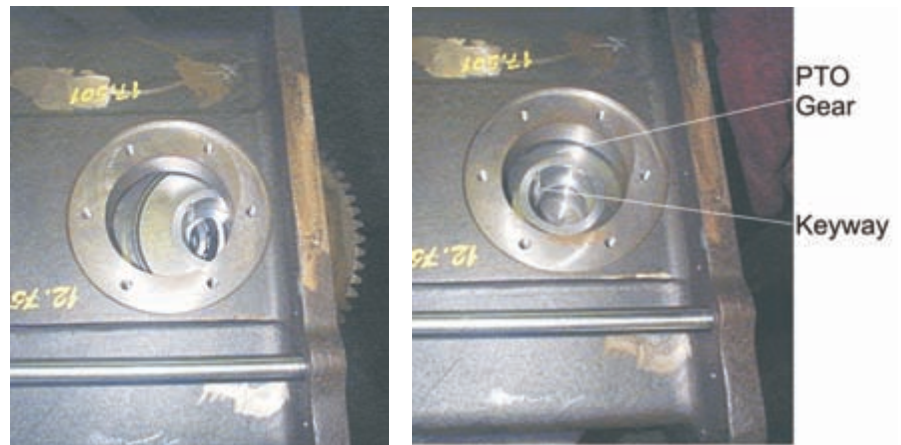


Figure 95. Installing PTO Gear

5. Fit the shaft into the bore of the gear; threaded holes facing up.
6. Drive the shaft into the gear using a copper hammer.

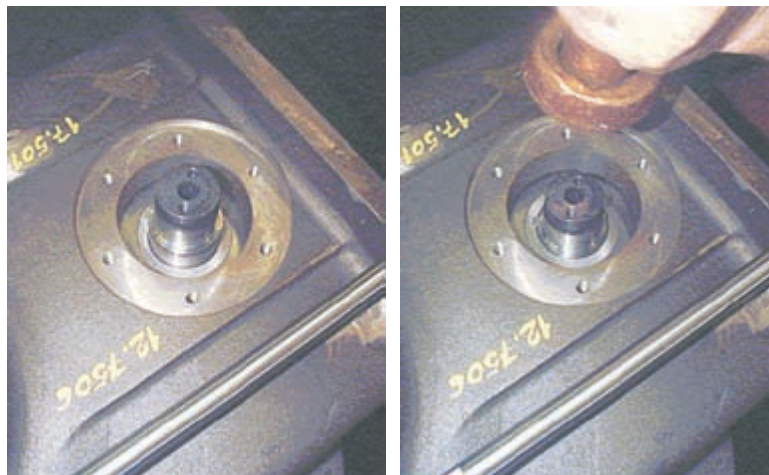


Figure 96. Shaft in Gear; Drive the Shaft into the Gear

7. Place spacing washer in position

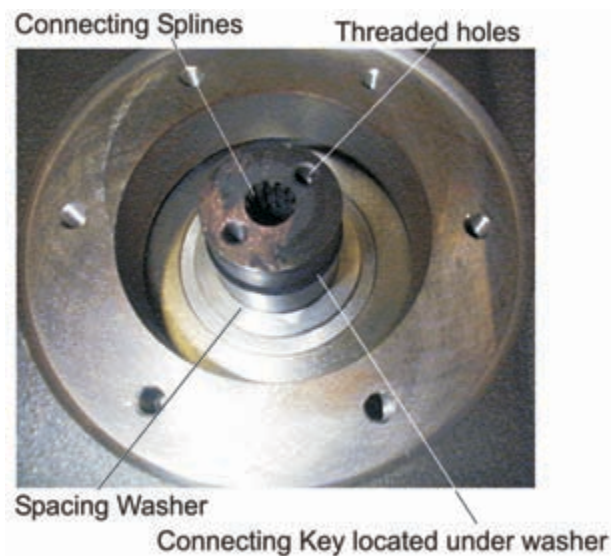


Figure 97. Place Spacer

8. Place the second bearing in position using a special tool and copper hammer.

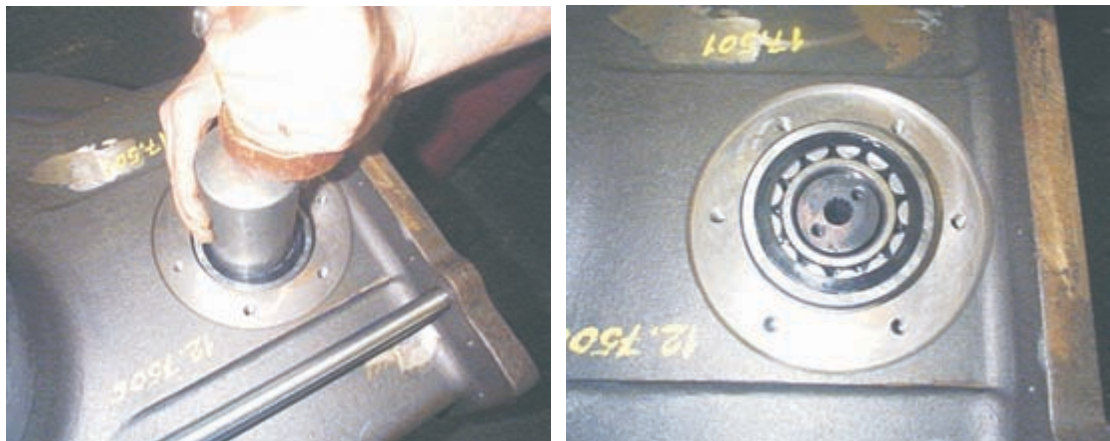


Figure 98. Placing the Second Bearing

Assembly of the Piston Carrier

Assemble the Piston Carrier, and Omega (if removed during disassembly)

1. Install the 1/8" NPTF plug into the piston carrier.
2. Install the ball bearing into the piston carrier bore.
3. Install the two gaskets and carrier omega, and secure each with four M8-1.25 x 35 sockethead capscrews on the piston carrier.
4. Install the screen filter, spring, and plug orifice into the bore of the omega. On the opposite side, fit the piston omega and gasket ; secure with two M6-1 x 15 sockethead capscrews.
5. Install the O-rings and Teflon® rings in the grooves of the piston, and fit the piston in the carrier.

Assemble the Seal Carrier

1. Heat the seal ring to 110°C (230°F) and put it on the shaft. Align and place the dog screw in the piston ring. Place the piston ring in the groove of the seal ring.

⚠ WARNING

Handle heated parts with care!

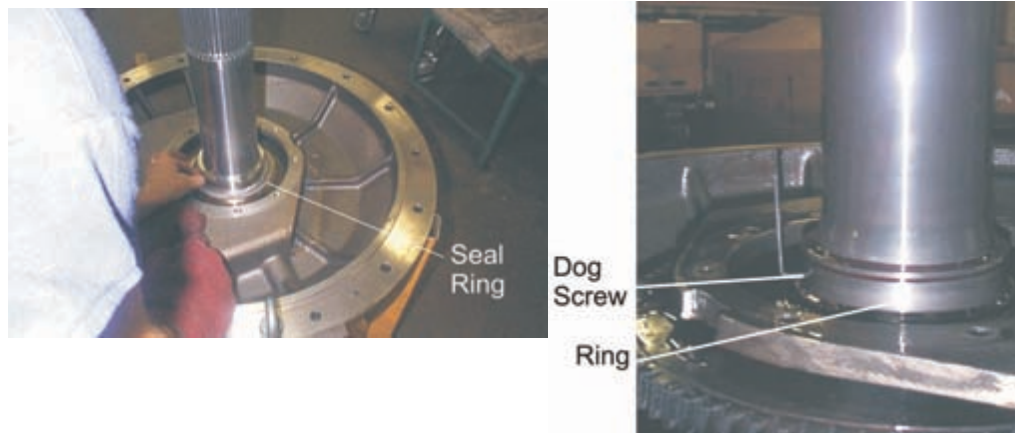


Figure 99. Seal Ring; Piston Ring

2. Place and secure the seal carrier using eight M12 - 1.75 x 35 hex head capscrews. Apply Loctite® 242 on the screw threads.
3. Tighten the screws to 90 Nm (65 ft-lb).

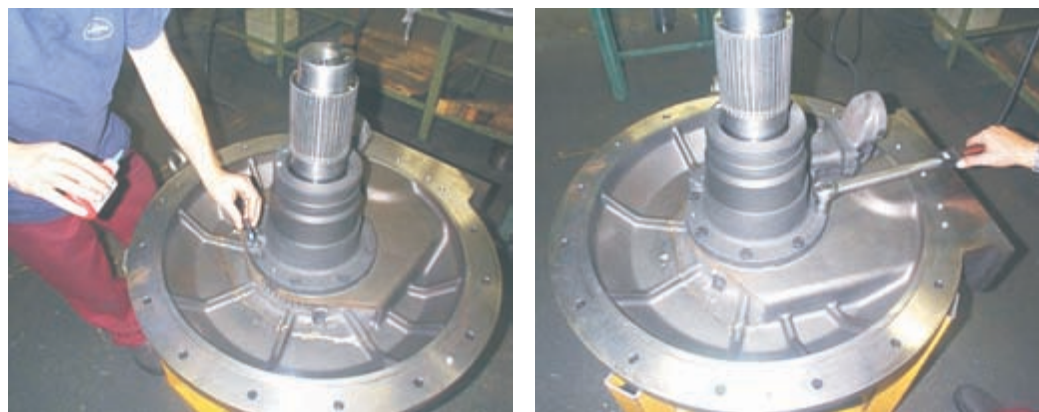


Figure 100. Seal Carrier

Install Piston Carrier

1. Place four piston rings, and coat them with grease.
2. With a lifting device, place the piston carrier.



Figure 101. Piston Rings; Piston carrier

3. Very carefully, lower the piston carrier, giving it a slight axial rotation.

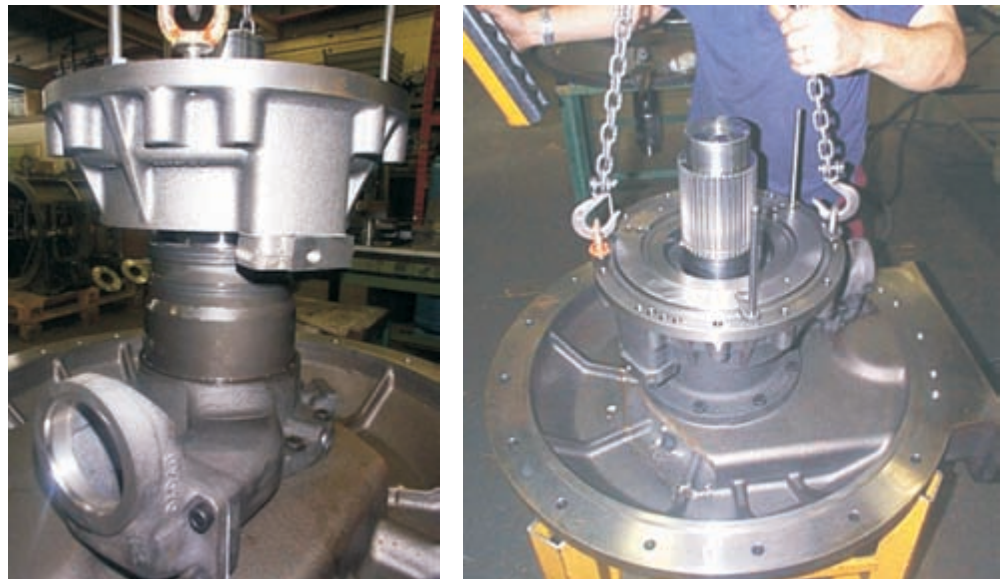


Figure 102. Carefully Lower Piston carrier

4. Support the piston carrier with a steel shim, 2 to 3 mm (0.080" to 0.110") thick, to prevent tilting.

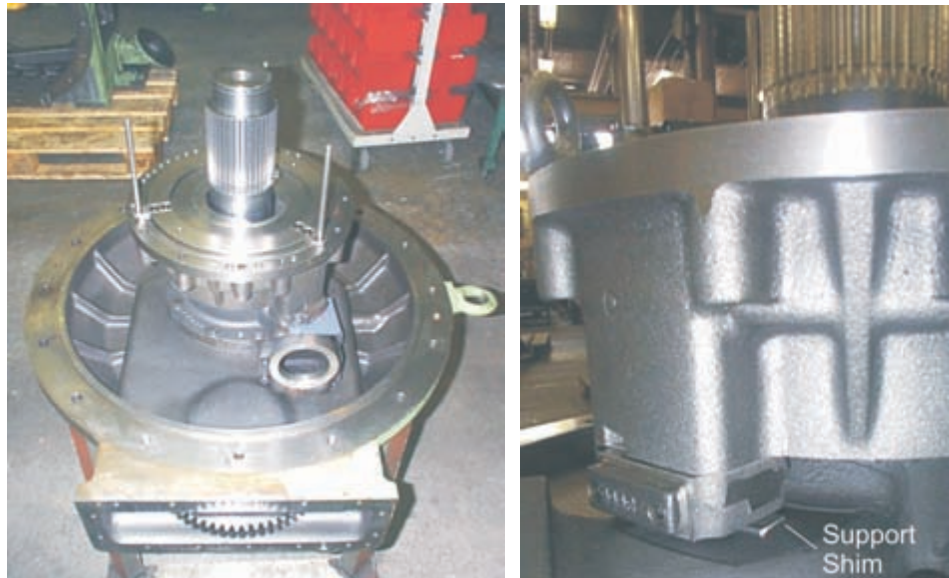


Figure 103. Piston Carrier Lowered and Supported

5. Attach a thrust plate to prevent the piston carrier from rotating around the shaft.



Figure 104. Piston Carrier with Thrust Plate

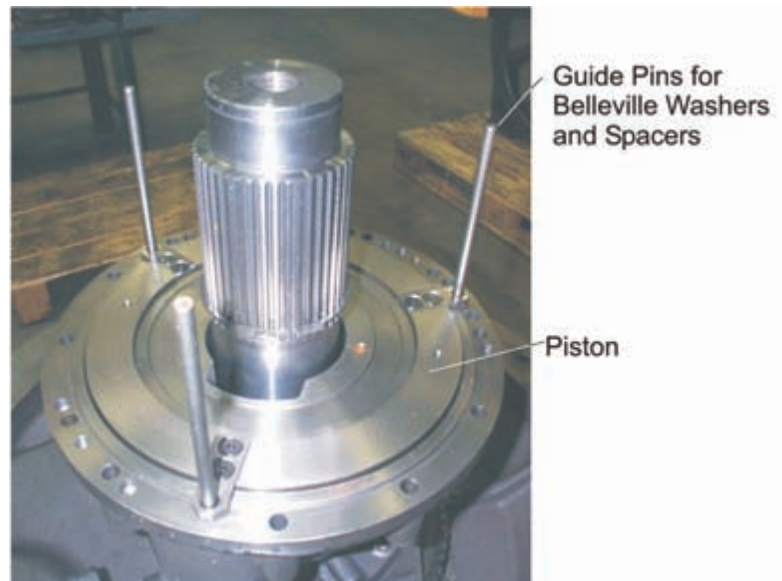


Figure 105. Guide Pins

6. Place the snap ring in the shaft groove to limit the down travel of the clutch hub.



Figure 106. Place Snap Ring

Assembly of Hub

1. Heat the inside of the clutch hub to 110°C (230°F).

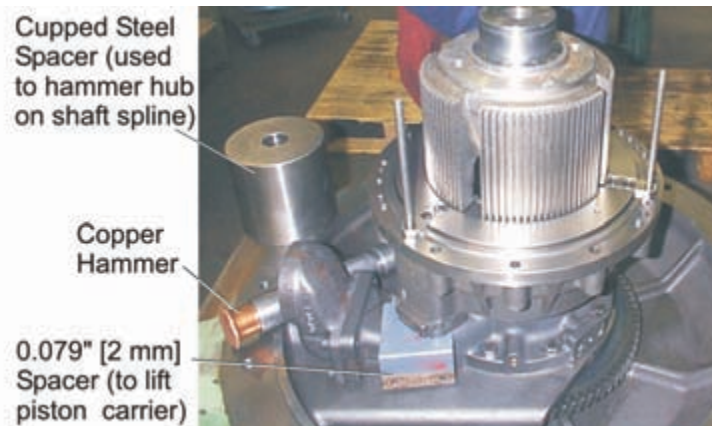
⚠ WARNING

Handle heated parts with care!



Figure 107. Heat the Hub

2. Use a cupped steel spacer to hammer the hub on the shaft spline. Ensure that the hub is down onto the snap ring.



Note: An alternate method would be to use a threaded rod with a hollow ram and a hydraulic pump to press the hub over the spline shaft.



Figure 108. Hub Down to Snap Ring

Assembly of Clutch Plates and Accessories

Description of Components

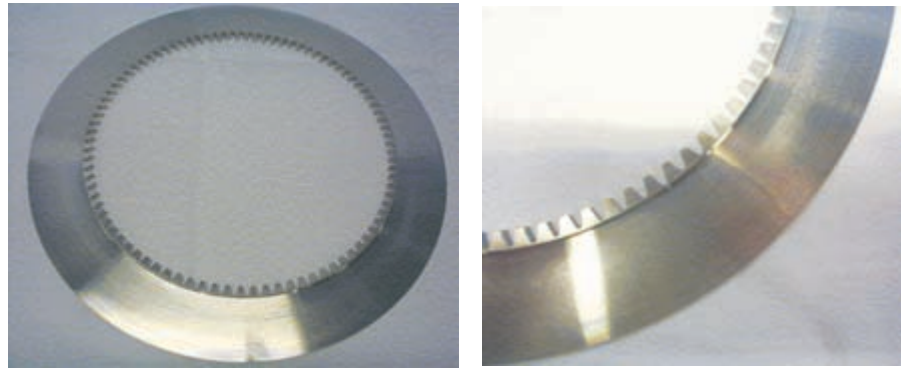


Figure 109. Steel Plate P-8045 with Internal Teeth

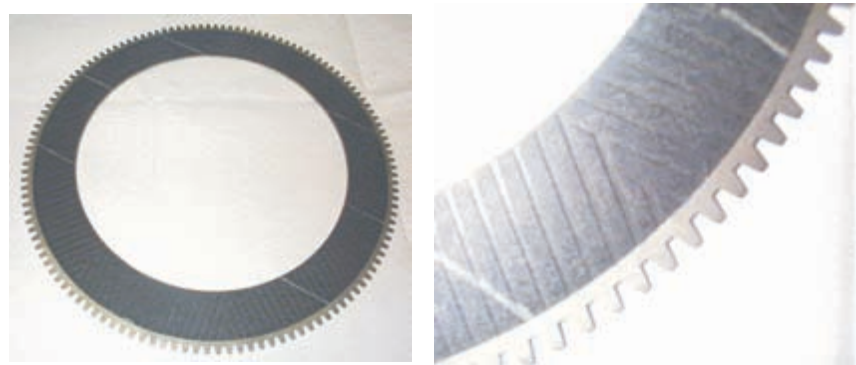


Figure 110. Friction Plate P-10890-A with Surface Grooves and External Teeth

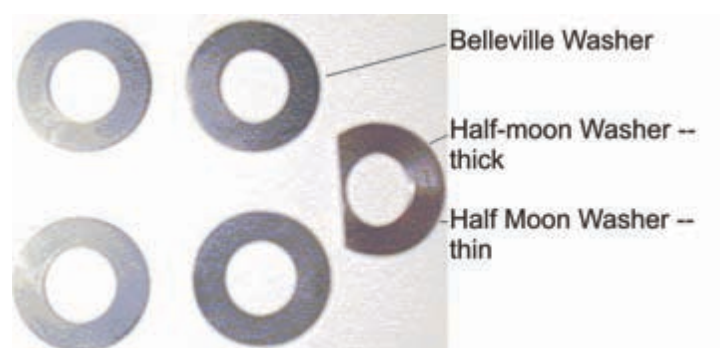


Figure 111. Washers

Assemble Clutch Plates and Accessories

1. Install the steel plates, friction plates, and washers; add three thick washers first, then the thin washers.

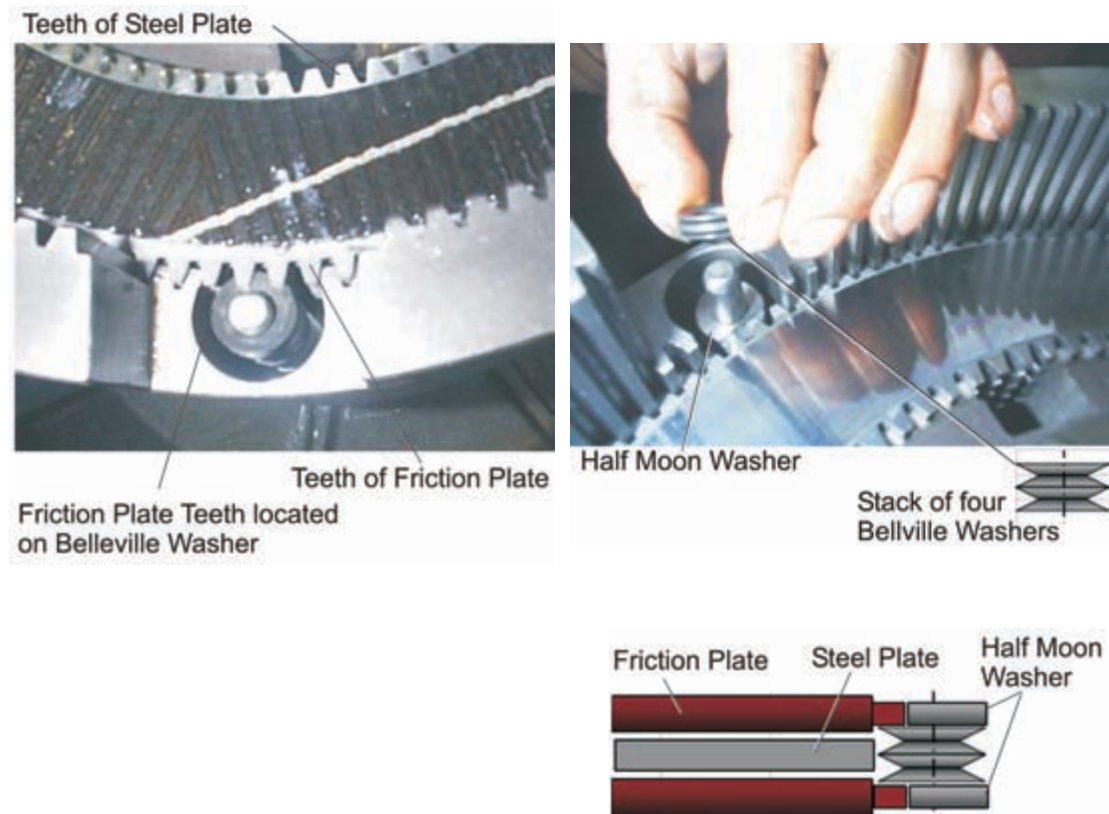


Figure 112. Plates and Washers

2. Install the backplate. Backplate must be located by three pins.
3. Before installing the clutch housing, verify the alignment of the clutch plates with a straight edge ruler.

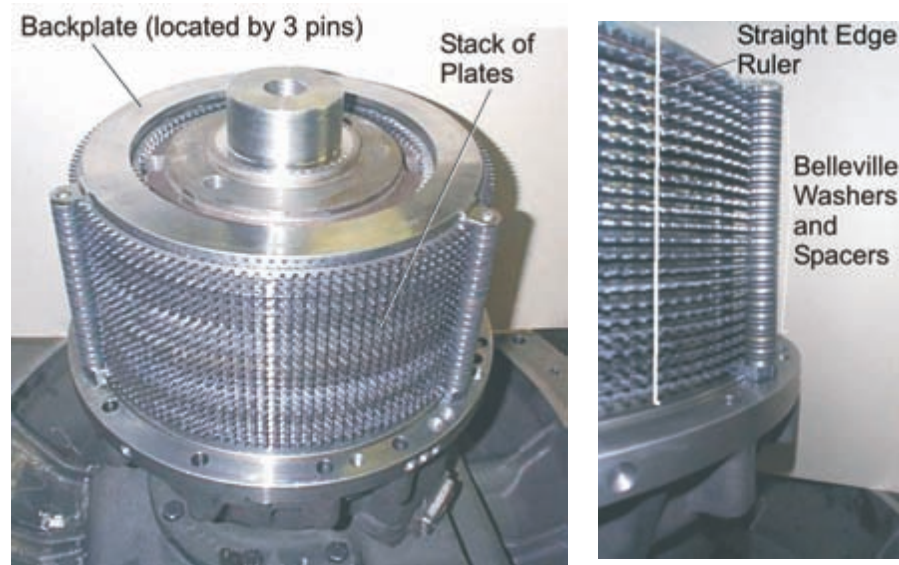


Figure 113. Install Backplate; Verify Alignment

Verify Clutch Release and Backplate

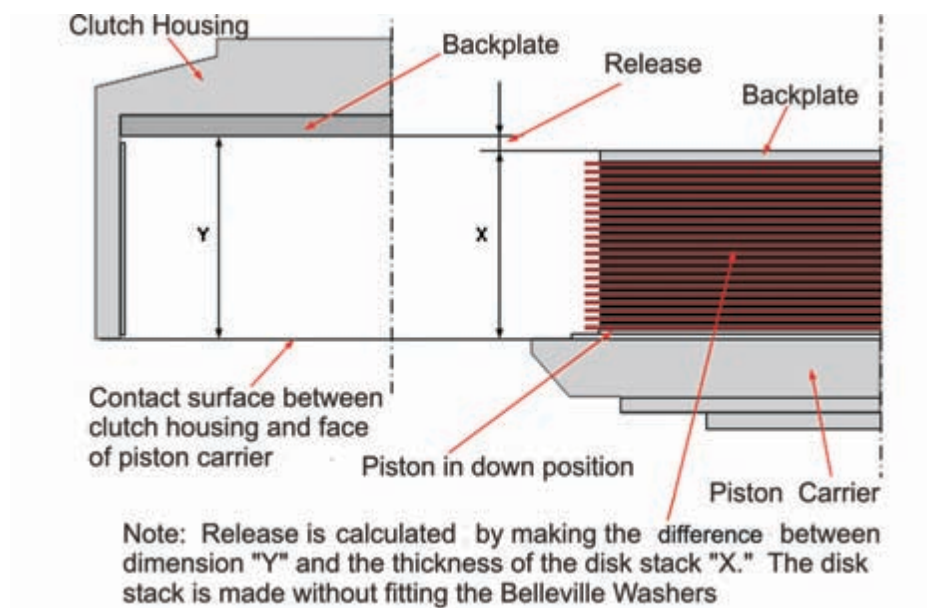


Table of Release Values

Example:

22 Steel Plates + 23 Friction Plates = 44 Active Faces

Table 10. Clutch Release Values

Active Faces	Release Values			
	Inches		Millimeters	
	Min.	Max.	Min.	Max
12	0.112	0.241	2.845	6.121
14	0.131	0.281	3.327	7.137
16	0.150	0.321	3.810	8.153
18	0.168	0.361	4.267	9.169
20	0.187	0.401	4.750	10.185
22	0.206	0.441	5.232	11.201
24	0.224	0.481	5.690	12.217
26	0.243	0.521	6.172	13.233
28	0.262	0.561	6.655	14.249
30	0.281	0.602	7.137	15.291
32	0.299	0.642	7.595	16.307
34	0.318	0.682	8.077	17.323
36	0.337	0.722	8.560	18.339
38	0.355	0.762	9.017	19.355
40	0.374	0.802	9.500	20.371
42	0.393	0.842	9.982	21.387
44	0.703	0.927	17.856	23.546

Comments



Figure 114. Washers, Spacers, and Housing

Installation of Clutch Housing

Align, Lower the Housing

1. Make sure the clutch housing splines are clean.



Figure 115. Clutch Components and Housing

2. With a hoist, position the clutch housing above the components. Using the marks made during disassembly, align the housing and piston carrier.

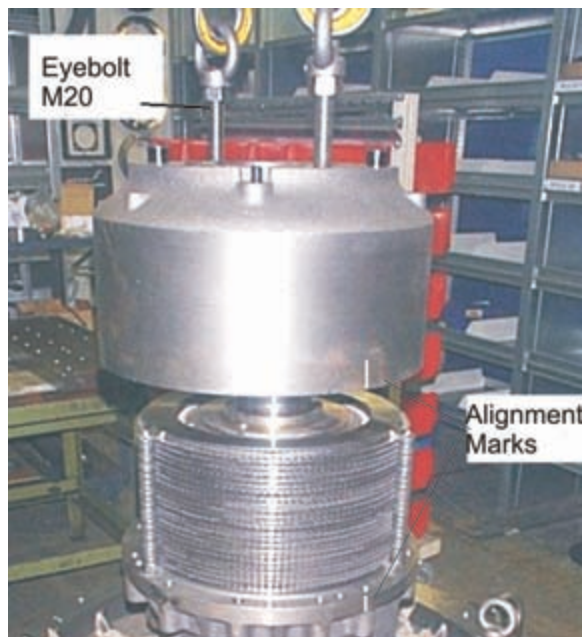


Figure 116. Install Housing

3. Allow the clutch housing to come down by its own weight. When it comes to rest, there must be a gap of 4 to 5 mm (0.157" to 0.197") between the housing and the shoulder of the piston carrier.

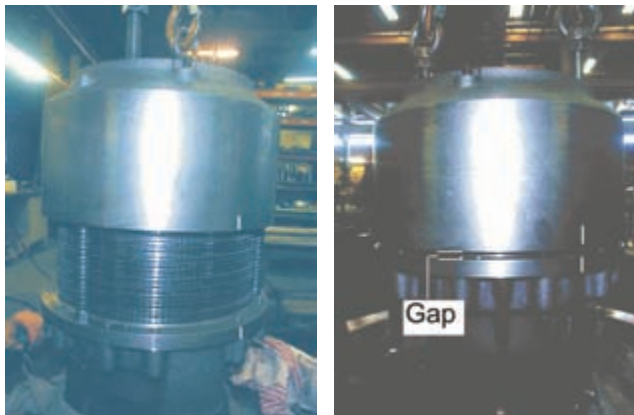


Figure 117. Gap Between Housing and Piston Carrier

Close the Clutch Housing

1. With (12) M20 - 2.5 x 70 socket head capscrews, bring the housing down until the two faces touch.

Note: Make sure that no hard spot is felt during that operation.

Note: During the above operation, the gap between the cover and the piston carrier must be equal at all times; and, in the end, the junction must be perfect.

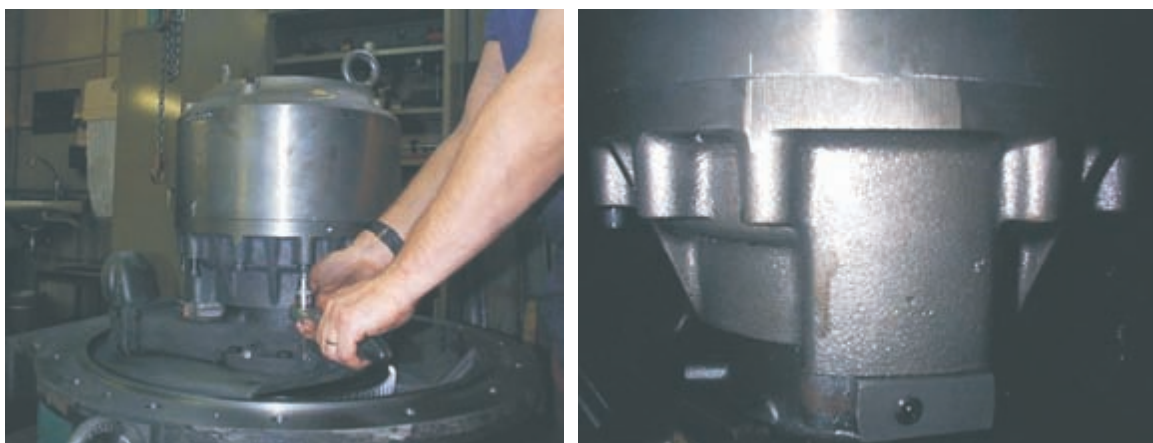


Figure 118. Joining Clutch Housing and Piston Carrier

2. Secure the clutch housing to the piston carrier with the capscrews. Tighten the screws to 138 Nm (100 ft-lb) with a torque wrench.



Figure 119. Secure the Housing

Assembly of Output Shaft, Housing and Cover

Assemble the Pilot Bearing

1. Inspect housing bore and shaft diameter before assembly. Install three “come home” screws (and dowel pins, if required). Ensure that the top of the screws are lower than the face of the housing.
2. Place the pilot bearing in its bore.



Figure 110. Place Pilot Bearing in Bore

3. Install the bearing over the shaft using a cupped steel spacer. Drive the bearing in place.



Figure 111. Install Pilot Bearing

4. Verify the bearing is in the correct position.



Figure 112. Pilot Bearing in Position

5. Install spacer and snap ring.



Figure 113. Pilot Bearing Spacer and Snap Ring

Assemble the Main Housing

1. With a hoist, position the main housing over the clutch assembly.



Figure 114. Lowering Main Housing

2. Place gasket on cover flange, and lower the housing into place. Make sure the locating pin enters the hole in the cover.



Figure 115. Gasket (left) and Main Housing in Position

Assemble Output Shaft and Accessories

1. Using a hoist, install the output shaft on the housing. Align the shaft flange holes with the locating pins.



Figure 116. Installing Output Shaft

2. Heat the hydraulics manifold to 110°C (230°F). Install the manifold, making sure it is correctly positioned.



Figure 117. Installing the Hydraulics Manifold

3. Apply Loctite® 242 to threads of (12) M20 - 2.5 x 70 socket head capscrews and tighten them with a torque wrench to 622 Nm (450 ft-lb).



Figure 118. Securing the Hydraulics Manifold

Assemble Retainer and Come Home Screws

1. Install and lubricate the piston rings before installing the retainer.

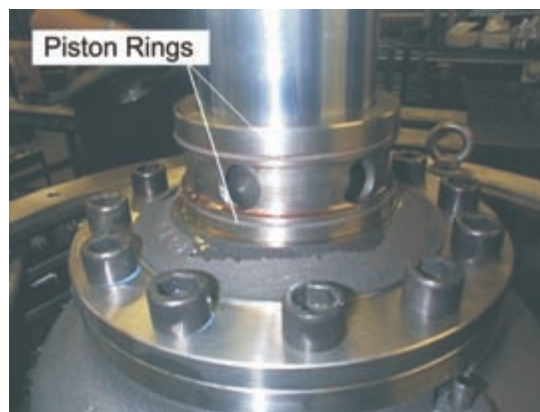


Figure 119. Piston Rings

2. Locate the three come home screws on the periphery of the clutch housing. Unscrew them until they are blocked against the shaft flange.



Figure 120. Back-off the Come Home Screws

3. Install the retainer. Slightly rotate the retainer back and forth to ease movement over the piston rings.



Figure 121. Installing the Retainer

4. Attach the collector. Place gasket on main housing and install guide rods.



Figure 122. Collector; Main Housing with Gasket and Guide Rods

Assemble Cover Spacer

1. Make sure the retainer is correctly positioned in the housing.



Figure 123. Correctly Position Retainer

2. Align the guide holes in the spacer with the guide rods in the main housing. Lower the spacer into place.

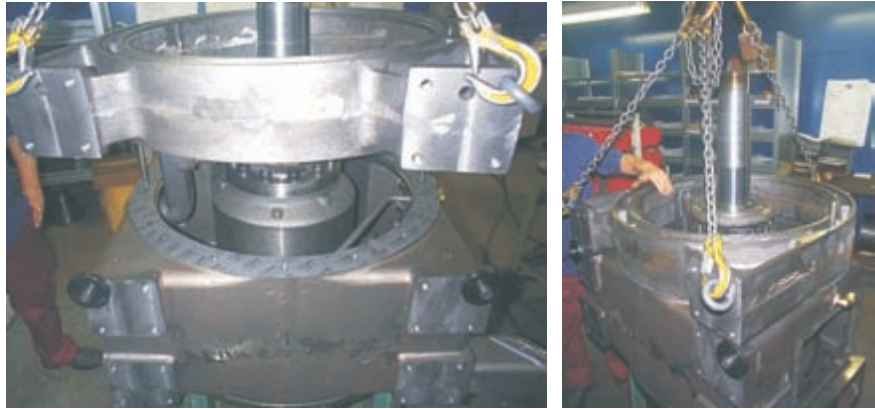


Figure 124. Cover Spacer in Position

Assemble the Output Cover

1. Inspect the bore for the output bearing.



Figure 125. Check Output Bearing Bore in Cover

2. Install the gasket on the cover spacer. Using a hoist, lower the cover into position on the spacer. Align the guide holes in cover with guide rods.



Figure 126. Installing Cover

3. Secure the cover to the spacer with (13) M16 - 2 x 210 hex head capscrews, two M16 - 2 x 220 hex head capscrews, and one M16 - 2 x 240 hex head capscrew. Tighten the screws to 110 Nm (80 ft-lb.)



Figure 127. Secure Cover to Spacer

Assembly of the Output Bearing

1. Install the lower bearing outer race.
2. Heat the bearings to 100°C to 110°C (212°F to 230°F).

⚠ WARNING

Handle heated parts with care!



Figure 128. Lower Race and Bearings

3. Install the first bearing
4. Install the second bearing.



Figure 129. Bearings

5. Apply Loctite® 603 to the periphery of the shaft before installing the seal race.



Figure 130. Seal Race

6. Install the upper outer race.



Figure 131. Upper Race

Adjustment of Output Shaft End Play

This procedure is necessary because the hydraulic manifold is also the thrust for the output bearings. This temporary installation of the manifold will allow you to adjust the bearing clearance. The manifold is secured by the same two screws that secure the output cover. You will remove the screws after adjustment is accomplished.

Adjusting the Output Bearing

1. Temporarily secure the manifold (retainer, collector), to the underside of the cover with two M12 x 40 hex head capscrews, and two spacers. (Remove spacers when the retainer is secured from the inside.)



Figure 132. Attach Hydraulic Manifold through Main Housing Cover

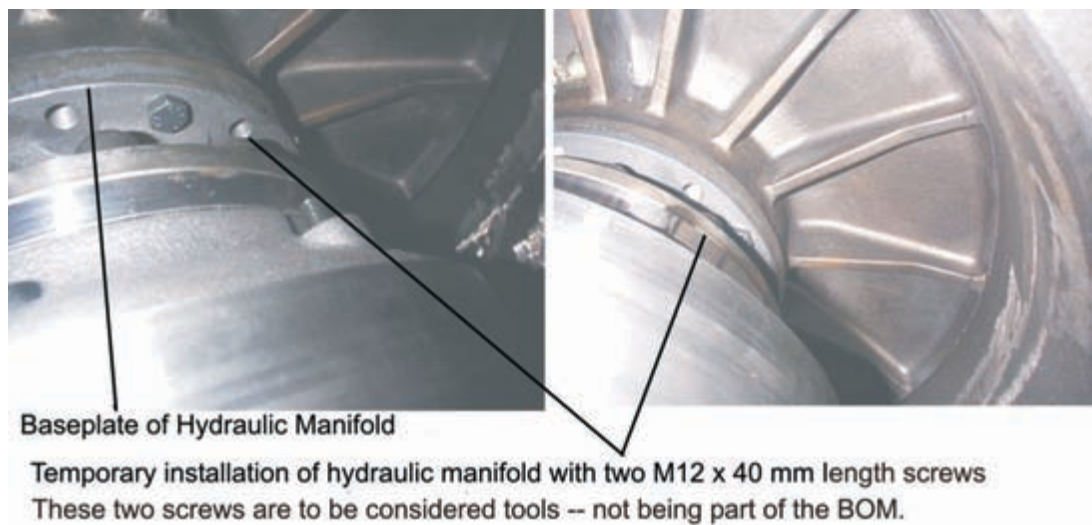


Figure 133. Underside of Main Housing Cover

2. Mount a dial indicator with a magnetic base on the main cover. Check the runout of the output shaft. Maximum allowable runout of input and output shaft is 0.127 mm (0.005").



Figure 134. Check Output Shaft Runout

3. Remove the spacer blocks and mount the output cover. Do not install the seals at this time.

Note: To avoid damage to the seals during this procedure, the seals will be installed after bearing adjustment is completed.

During final assembly of the shim pack, Loctite® 574 will be applied to each shim.



Figure 135. Output Cover Without Oil Seals

Adjust End Play of Input and Output Bearings

Note: Before setting end clearance, remove the 2 to 3 mm (0.079" to 0.118") shim from under the piston carrier. Be sure the piston carrier and shaft assembly drop, so the lower bearing cone is correctly located in the cup of the outer race.

1. Place the assembly on a fixed support.
2. Slightly lift the shaft with a hoist.
3. Calculate the shims required to obtain maximum axial play of 0.127 mm (0.005"). MINIMUM tolerance of 0.038 mm (0.0015"). These values are applicable to both the input and the output shafts.
4. Lower the shaft so the bearing seats in the outer race.



Figure 136. Set End Play for both Output and Input Shafts

Assembly of Adapter and Mounting Plates

Assemble Block Mounting Plate

1. Install the guide rods, hydraulic connectors, and panel gasket

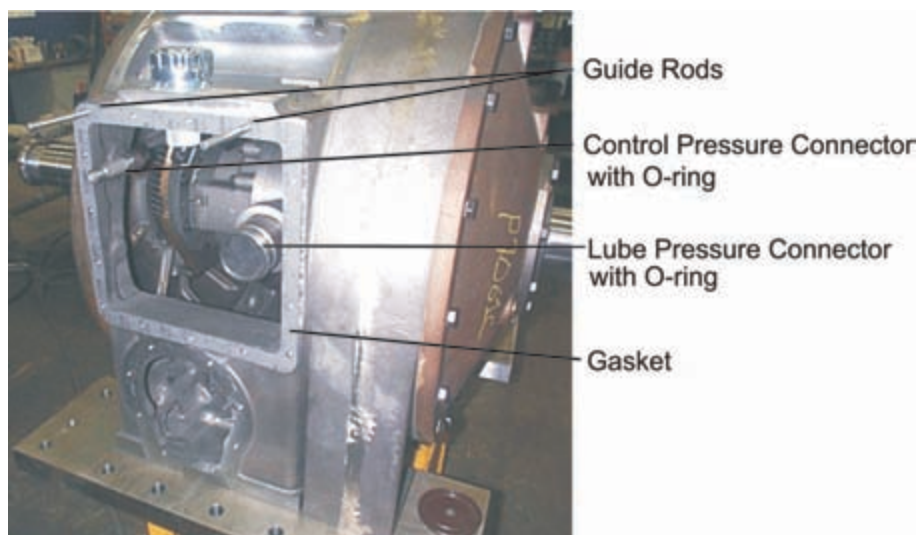


Figure 137. Unit Ready for Panel Installation

2. Install the mounting plate
3. Apply grease to the gasket, and install the gasket P-7077-A on the panel. (Use gasket P-7251 on units built before 1990.)

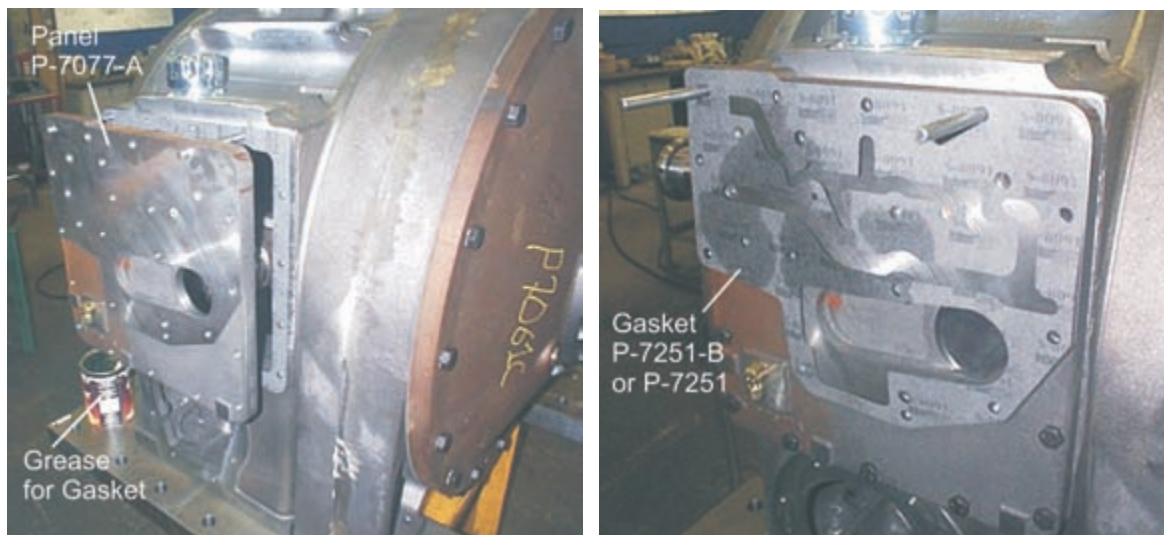


Figure 138. Panel and Valve Gasket

Assemble Side Adapter Plate

1. Inspect the side adapter plate and installation of the various accessories: pressure probe, temperature probe, etc.

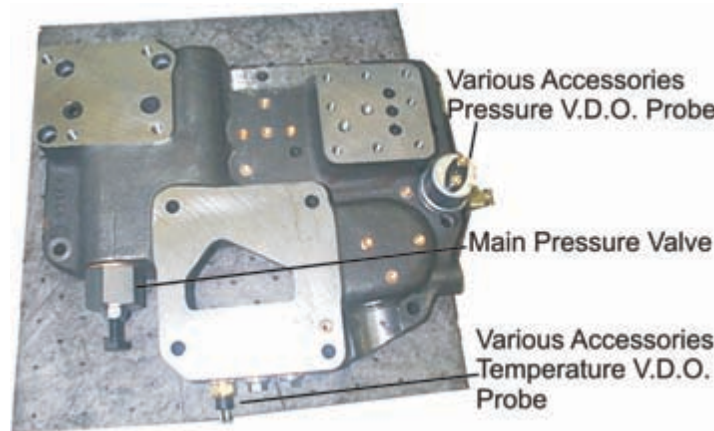


Figure 139. Adapter Plate with Accessories

2. Install the adapter plate over the guide pins.



Figure 140. Installing the Adapter Plate

3. Secure the adapter plate and the mounting plate with nine M10 - 1.5 hex head capscrews: (7) 35 mm long, (1) 65 mm, and (1) 40 mm; and six M10 - 1.5 socket head capscrews: (3) 90 mm long, (2) 65 mm, and (2) 55 mm. Tighten the screws to 58 Nm (42 ft-lb).



Figure 141. Adapter Plate Secured on Mounting Plate

Installation of Valve Blocks

1. Assemble lubrication valve block.
 - A. Install the lube valve assembly with three M10 - 1.5 x 160 socket head cap screws, and one M10 - 1.5 x 140 socket head capscrew. Tighten to 58 Nm (21 ft-lb).

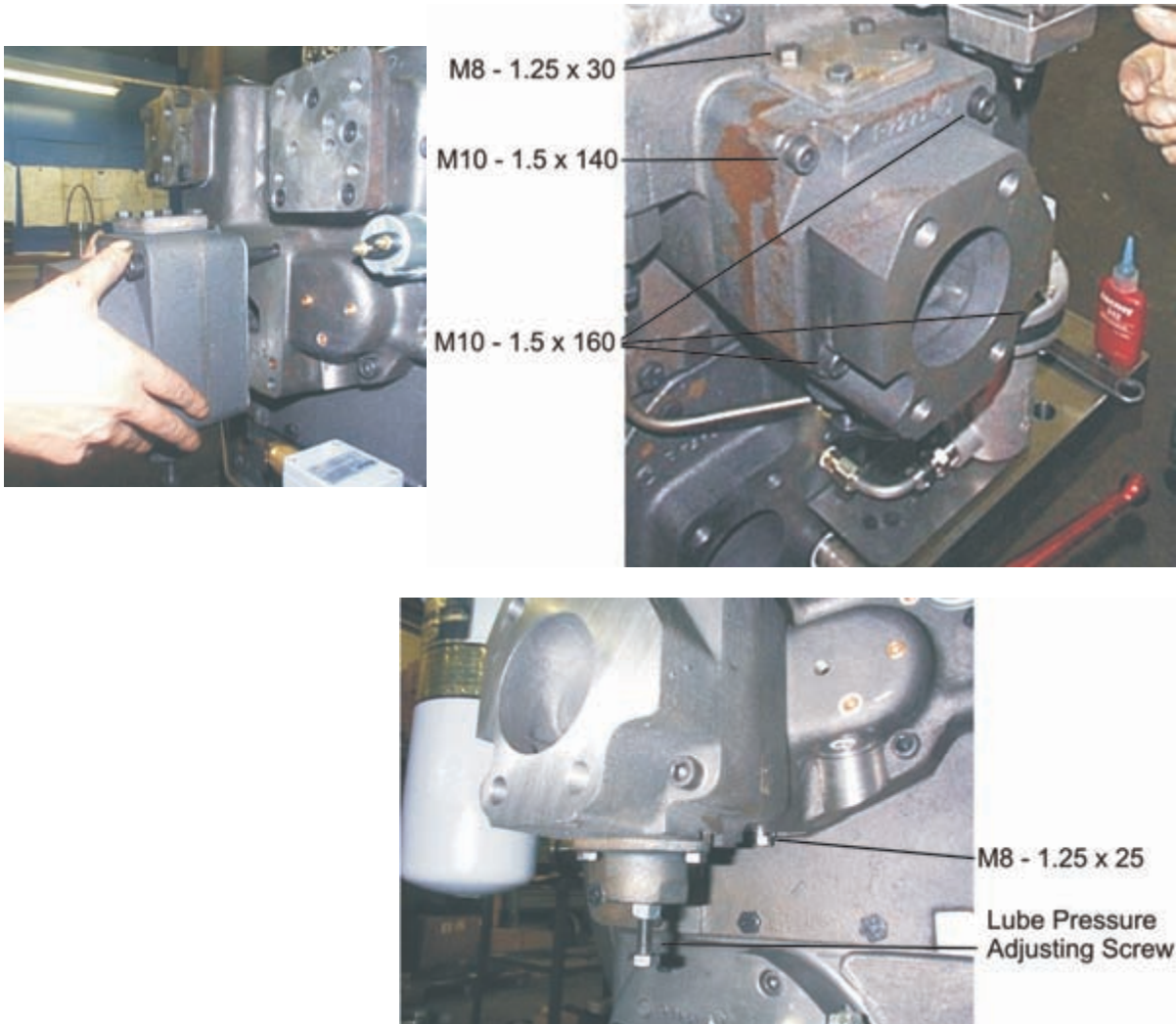
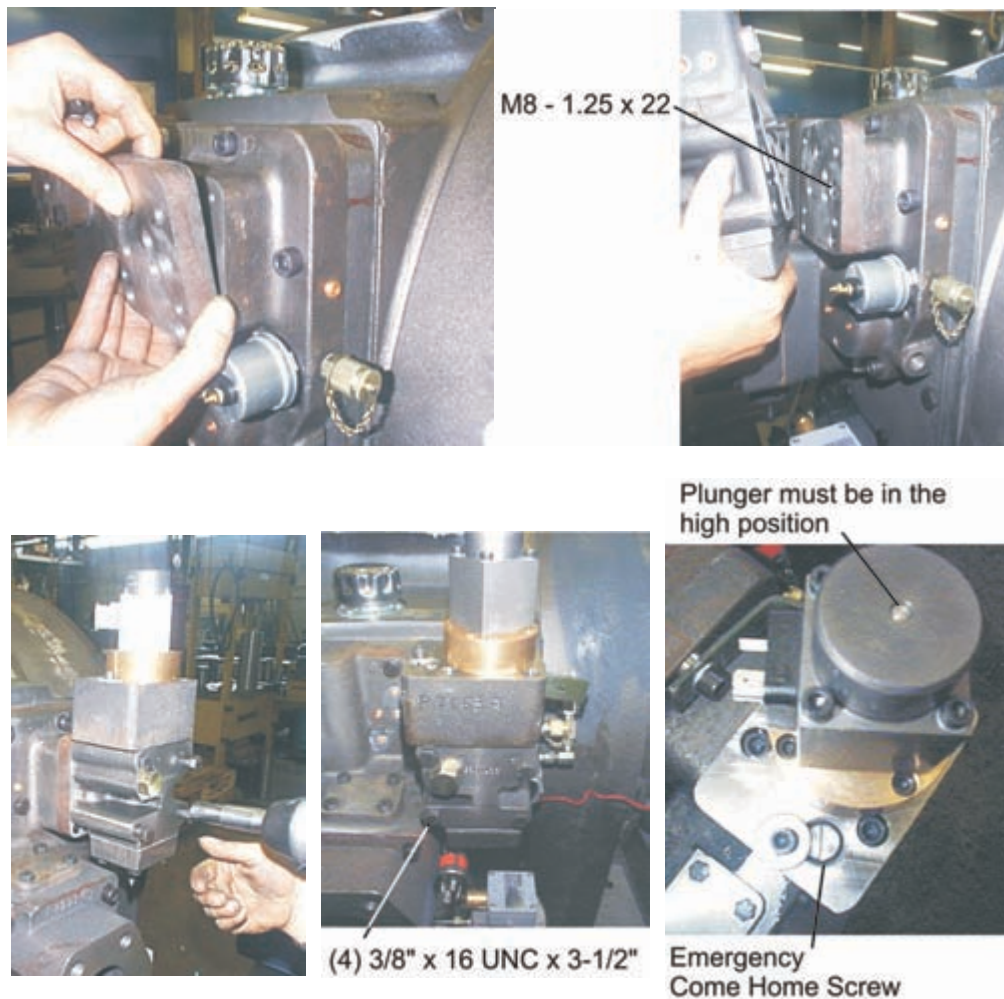


Figure 142. Lube Valve Assembly

B. Install Servo Valve

1. Install gasket spacer. Secure with M8 - 1.25 x 22 socket head capscrew. Tighten to 37 Nm (17 ft-lb).
2. Mount the servo valve and gasket with four 3/8" x 18 UNC x 3-1/2" hex head capscrews. Tighten to 44 Nm (32 ft-lb).

**Figure 143. Installation of Servo Valve**

C. Install the Filter

1. Install spacer with M10 - 1.5 x 35 socket head capscrews.
2. Mount the filter. Secure with M10 - 1.5 x 25 hex head capscrews.

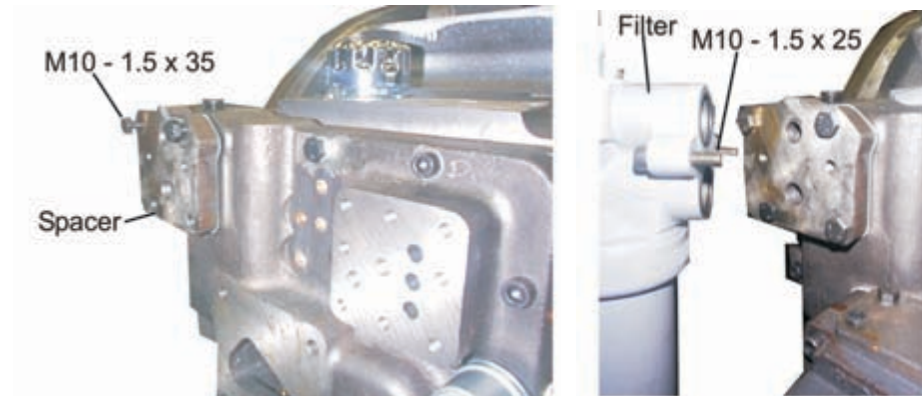


Figure 144. Installation of Oil Filter

Install the Lube Pump Adapter Plate

1. Install hydraulic connector for trailing pump.

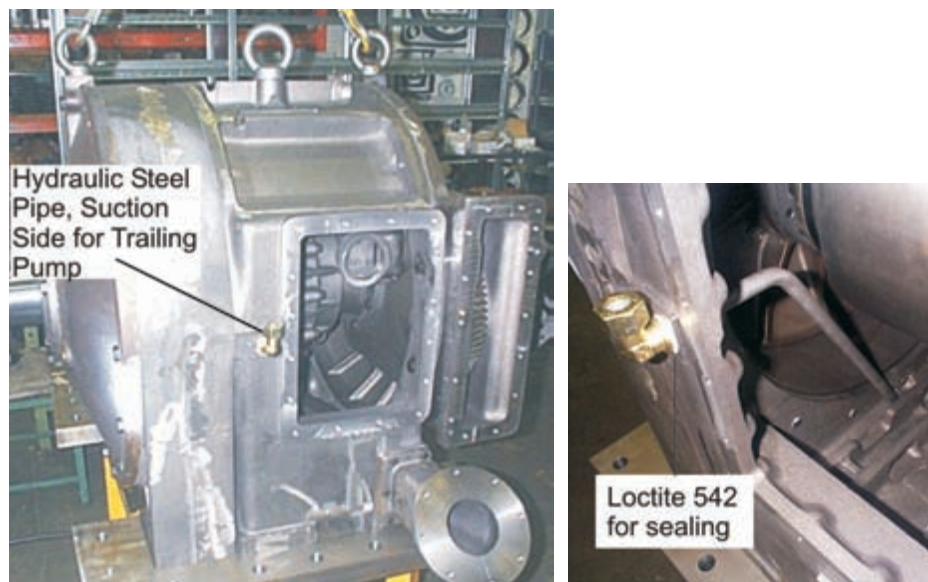


Figure 145. Trailing Pump Connection

2. Install gasket with grease.
3. Apply grease in bore for the O-ring, and install the hydraulic pipe.

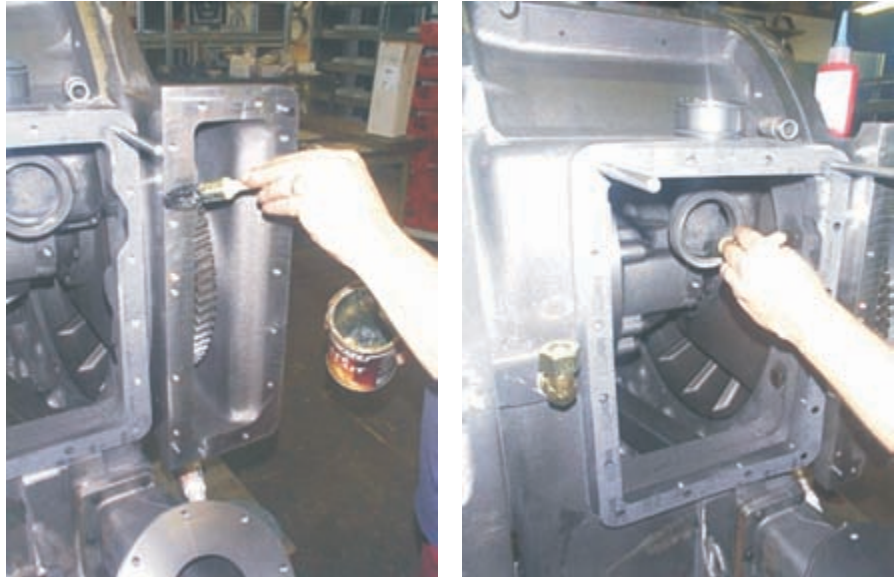


Figure 146. Grease Gasket and Hydraulic Bore

4. Install the adapter plate using the two guide rods.



Figure 147. Lube Pump Adapter Plate

5. Secure the plate with (13) M10 - 1.5 x 35 hex head capscrews, and one M10 - 1.5 x 30 socket head capscrew (the fifth position from the top, left side). Tighten the screws to 58 Nm (42 ft-lb).

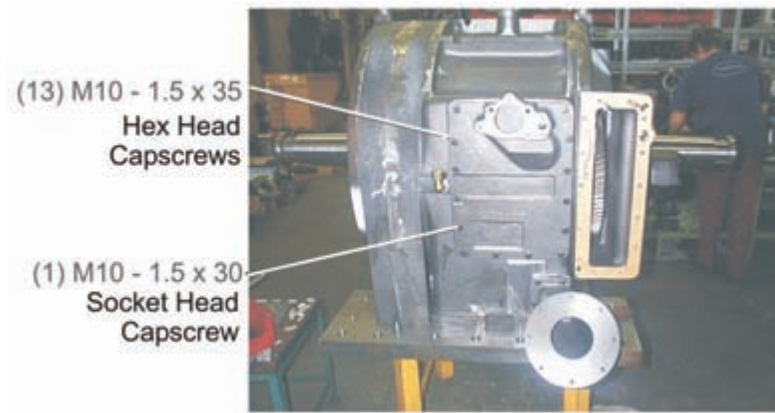


Figure 148. Lube Pump Panel

Assemble the PTO Side Panel

1. Apply grease to the gasket and place it on the flange of the housing.

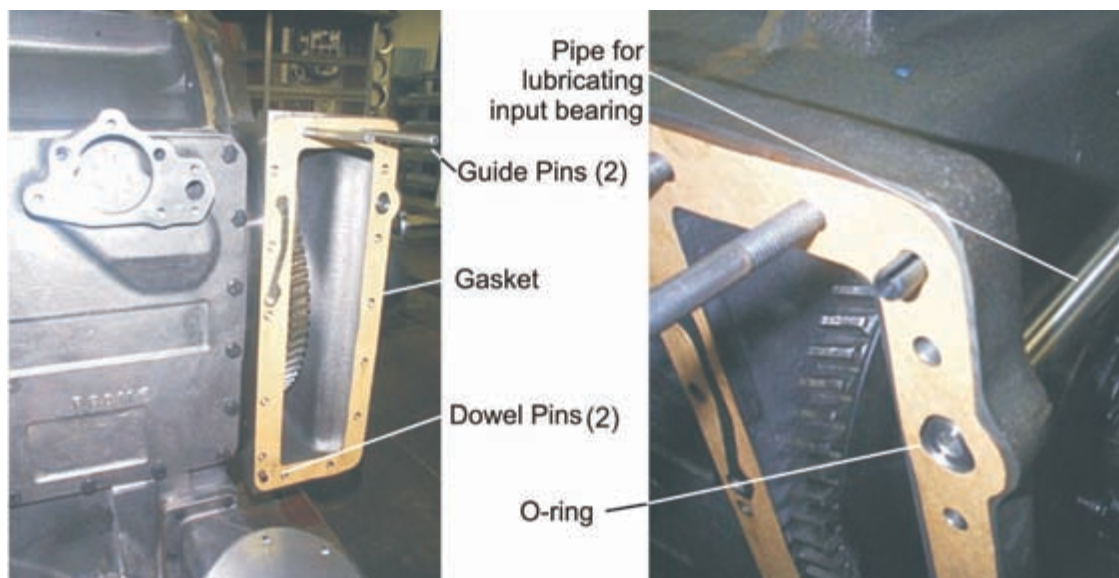


Figure 149. Housing Flange for PTO Cover

2. With a hoist, lift the PTO cover assembly and place it to the housing. Take care to avoid damaging the gasket.



Figure 150. Carefully Place the PTO Cover Assembly

3. Secure the cover assembly to the housing with (13) M10 - 1.5 x 30 hex head capscrews, and one M10 - 1.5 x 25 hex head capscrew. Before securing the cover, make sure two orifice plugs are secured in the PTO housing. Tighten the screws to 58 Nm (42 ft-lb).

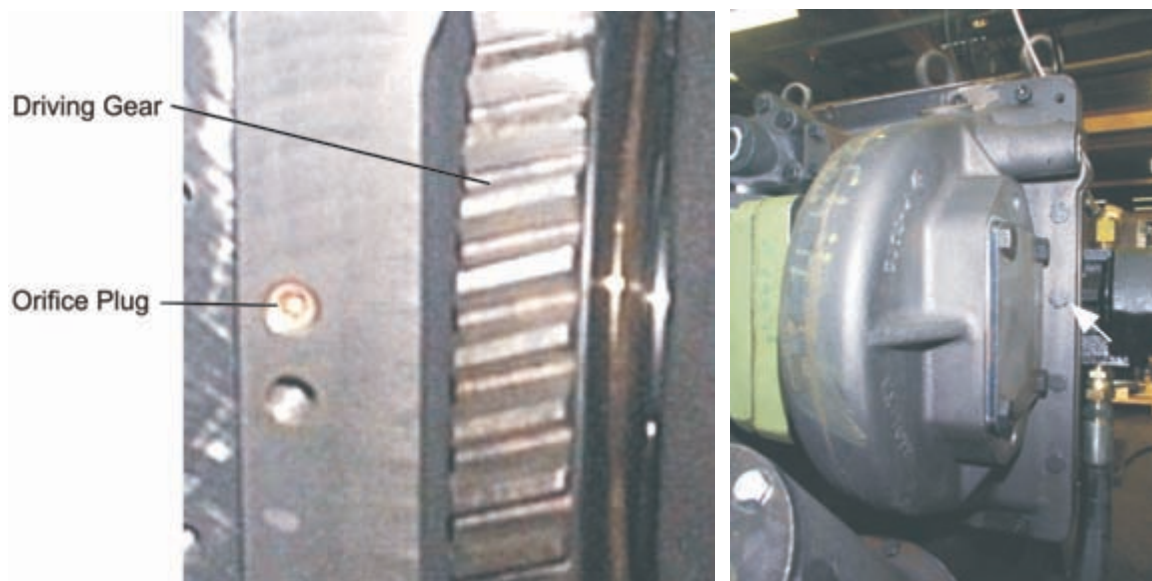


Figure 151. PTO Cover Mounted

Assembly of Lubrication Pump

Installation of Pump

1. Position the pump adapter. Apply Loctite® 242 to the threads of the four M12 - 1.25 x 30 socket head capscrews, and mount the adapter to the housing. Tighten the screws to 138 Nm (100 ft-lb).



Figure 152. Lube Pump Adapter

2. Lift the lube pump with a hoist and place it against the adapter. Secure with four screws.

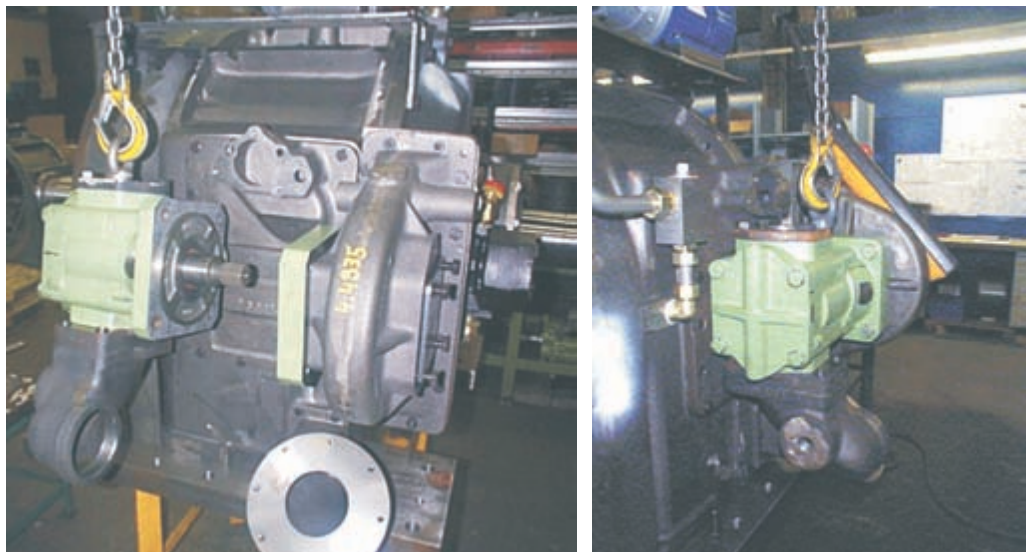


Figure 153. Lube Pump

3. Connect with hydraulic collector. If necessary, use a copper hammer to facilitate pump installation.



Figure 154. Connecting Hydraulic Collector

Assemble Pump Accessories

1. Secure the lubrication collector for the input bearings with two M8 - 1.25 x 70 socket head capscrews.

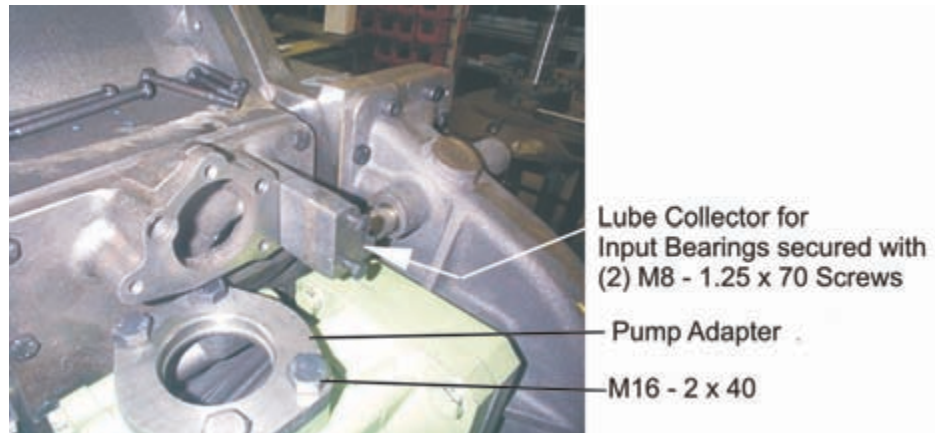


Figure 155. Lube Collector for Input Bearings

2. Assemble the pump discharge manifold. Secure with four M10 - 1.5 hex head capscrews: (1) 150 mm long, (1) 100 mm, and (2) 70 mm. Tighten the screws to 58 Nm (42 ft-lb).



Figure 156. Manifold Assembly

Installation of Main Pressure Pump

1. Mount the spacer to the housing with six M10 - 1.5 x 30 socket head capscrews. Apply Loctite® 242 to the screw threads. Tighten the screws to 58 Nm (42 ft-lb).



Figure 157. Spacer

2. Mount the pump and secure with four M10 - 1.5 x 25 socket head capscrews. Tighten the screws to 58 Nm (42 ft-lb).

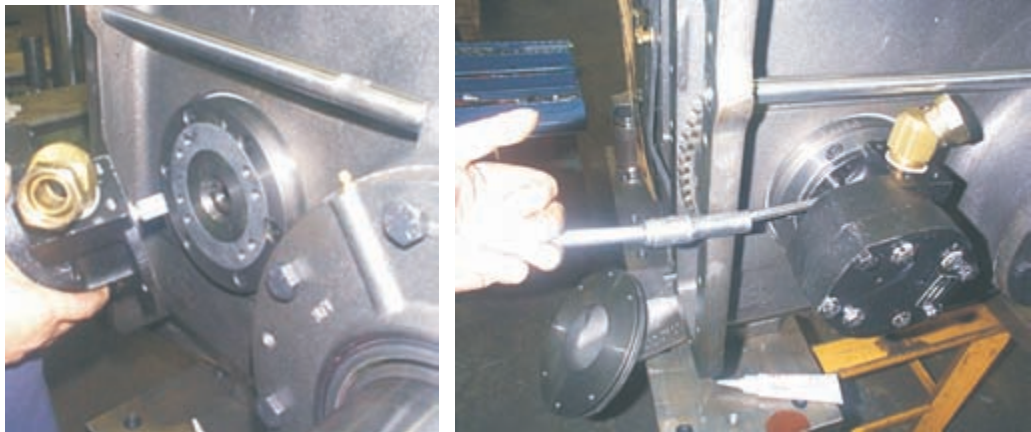


Figure 158. Torque the Mounting Screws

3. Attach flexible hydraulic hose to the pressure side of the pump. Then attach flexible hydraulic hose to the suction side of the pump.



Figure 159. Connect Hoses

Adjustment of Hydraulic Valves

1. Using two 17 mm hex wrenches, adjust the regulating screws of the main pressure valve, and the lube pressure valve. Turn the screw clockwise to increase the pressure.

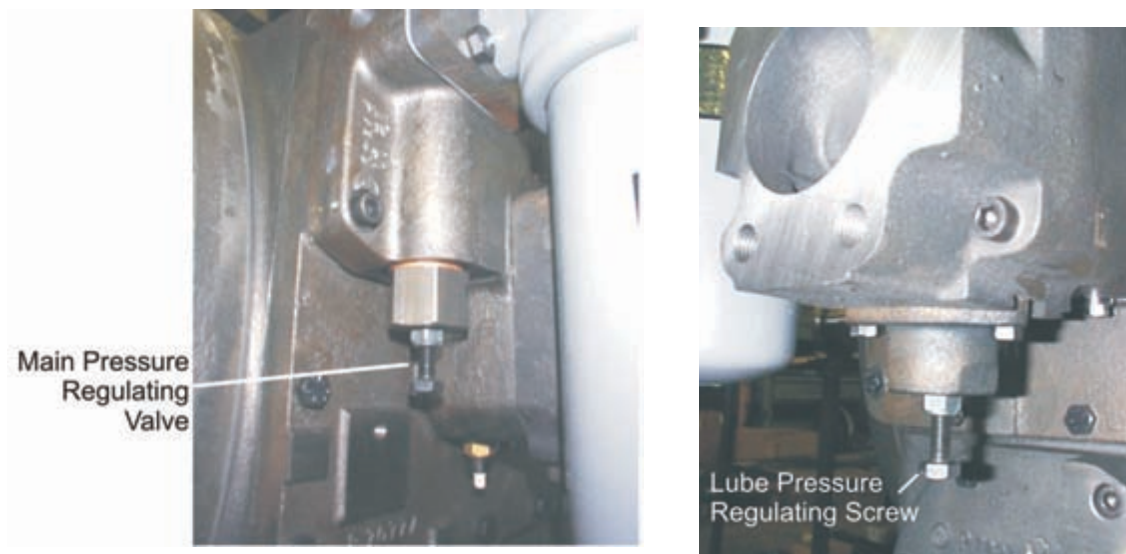


Figure 160. Regulating Screws of Main Pressure and Lube Pressure

2. Using a 14 mm wrench and a screwdriver, turn the regulating screw clockwise to decrease the residual control pressure.

Note: Residual pressure is factory adjusted and cannot be modified in the field. For maintenance purposes, record the length of the screw protruding from the cover.

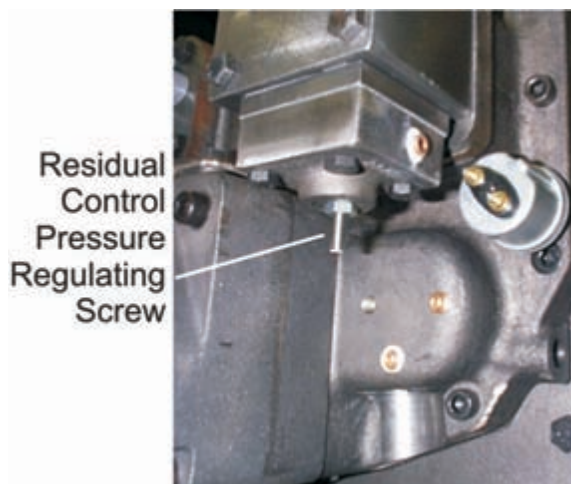


Figure 161. Residual Control Pressure Adjusting Screw

3. You can adjust the pressure of the emergency manual clutch engagement valve. Turn the screw clockwise to increase the pressure, and counter-clockwise to decrease pressure.



Figure 162. Emergency Clutch Engagement Valve

4. Adjustment of the omega valve is not required.

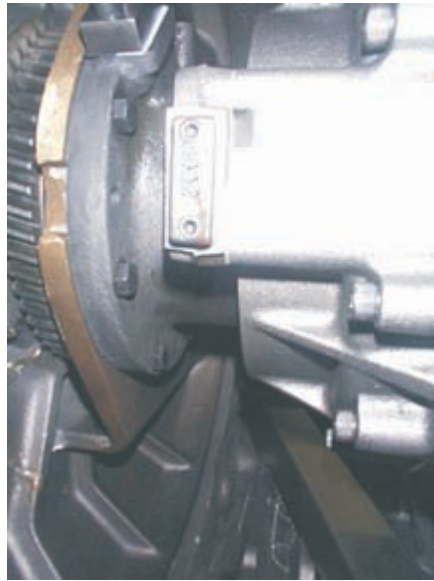


Figure 163. Omega Valve

A. U. T. Alarms and Control Devices

Pressure and Temperature Sensing Modules

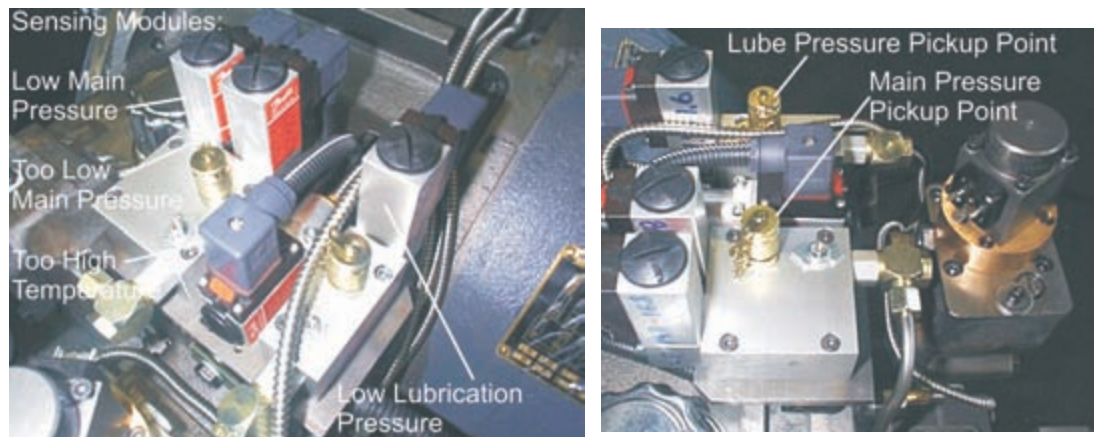


Figure 164. Sensing Modules

Low Oil Level Detection

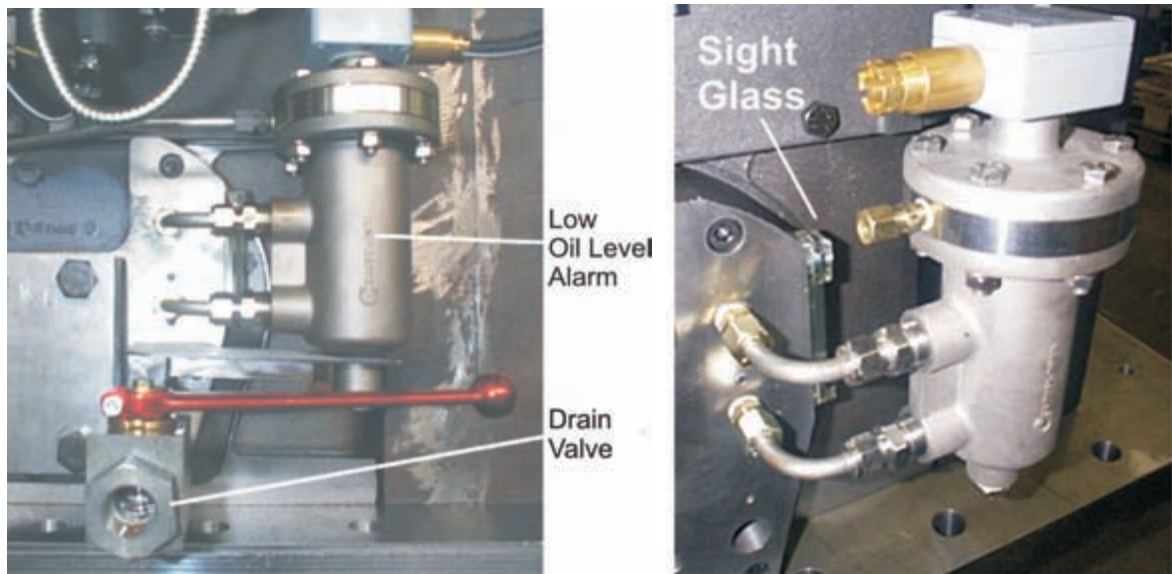


Figure 164. Oil Controls

Filter Clog Detector



Figure 165. Oil Filter Components

V. D. O. Switches

Coil impedance at ambient of 25°C (77°F):

- Control Pressure: 10 ohms
- Lube Oil Temp: 600 ohms

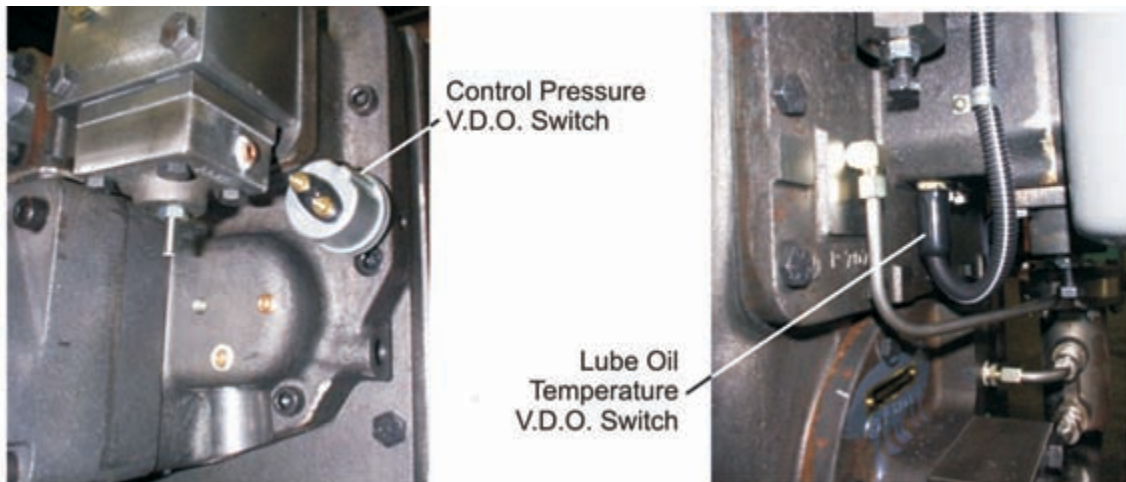


Figure 166. Control Pressure and Lube Oil Temperature Switches

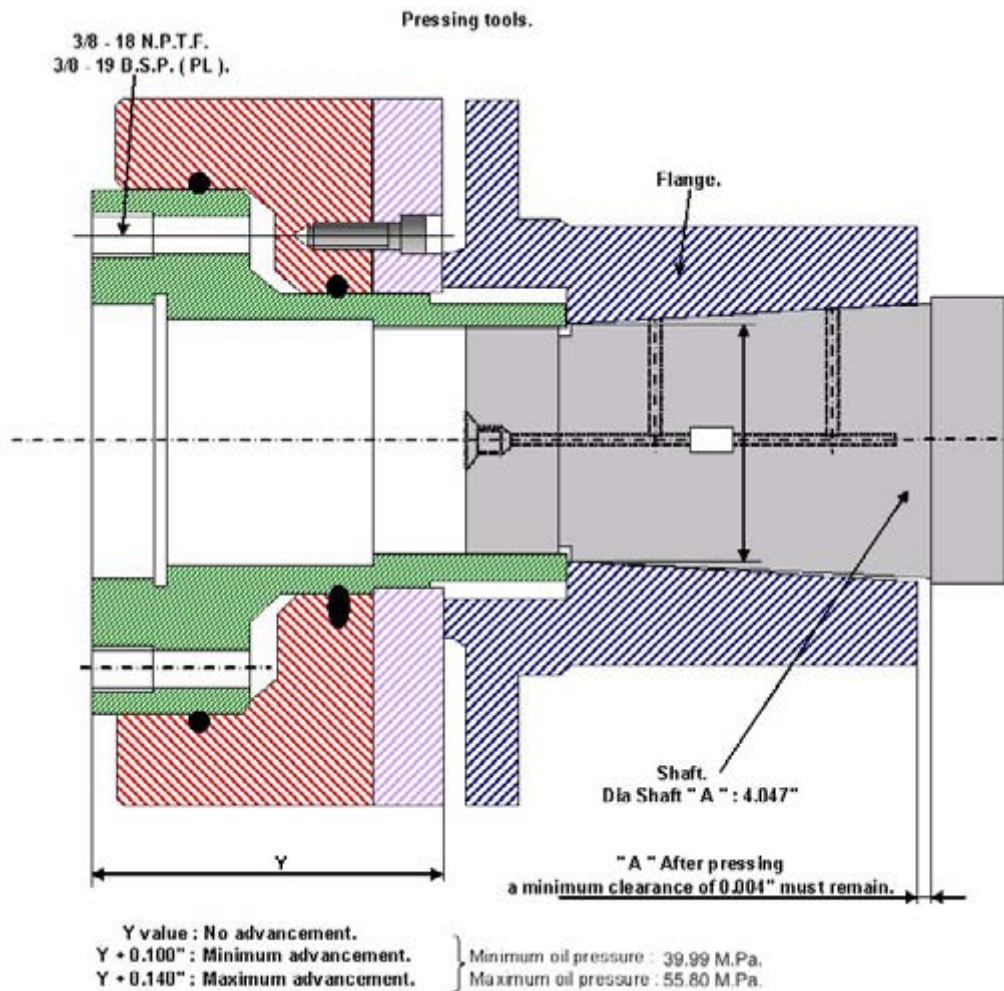
Servo-valve

- ❑ For proper operation, the plunger must be flush with the top face of the valve.
- ❑ Driving the control pressure of the clutch.
At ambient of 25°C (77°F), the impedance of the coil is at 20 ohms.



Figure 167. Servo Valve

Mount Flanges



Advance Specifications (For MCD 3000)

Y dimension:	Measurement before applying any pressure.
Y + 2.540 mm (0.100"):	Minimum advance; Minimum pressure 39.9 Mpa (5786 psi)
Y + 3.556 mm (0.140"):	Maximum advance; Maximum pressure 55.8 Mpa (8100 psi)

Assembly Instructions (For MCD 3000)

1. Remove all dirt, burrs and scratches, and clean properly. Before mounting, check visually for a perfect fit of male and female taper length.
2. Clean the contact surfaces with a solvent like Loctite® cleaner.
3. Install (screw) the special tool on the output shaft until it touches the output flange.
4. Measure the distance “Y” on the special tool before applying pressure.

Apply a minimum of 5786 psi (39.9 Mpa) to obtain an advance of the output flange of 2.54 mm (0.101”).

Apply a maximum of 8100 psi (55.8 Mpa) to obtain a total advance of 3.556 mm (0.140”).

Both the advance limits must be considered.

5. Check dimension “A” after assembly.

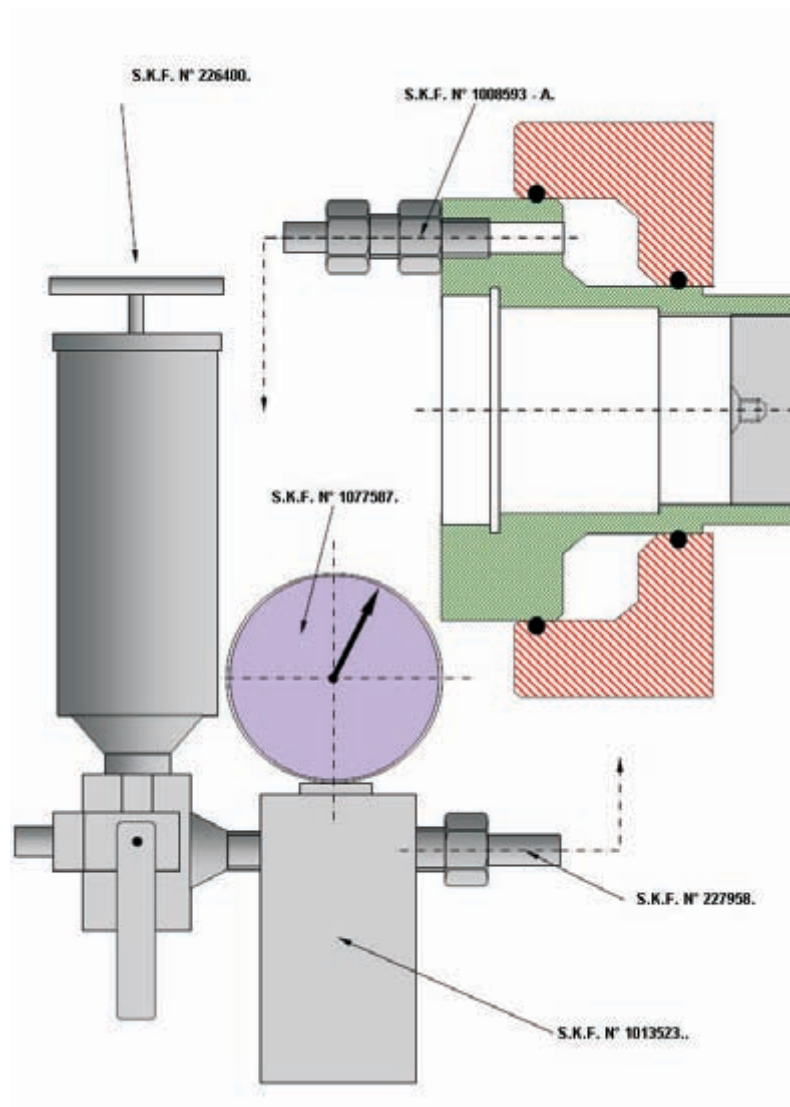


Figure 168. Oil Injector

Installation

General

The MCD unit is usually installed between the prime mover (usually) and the rudder propeller.

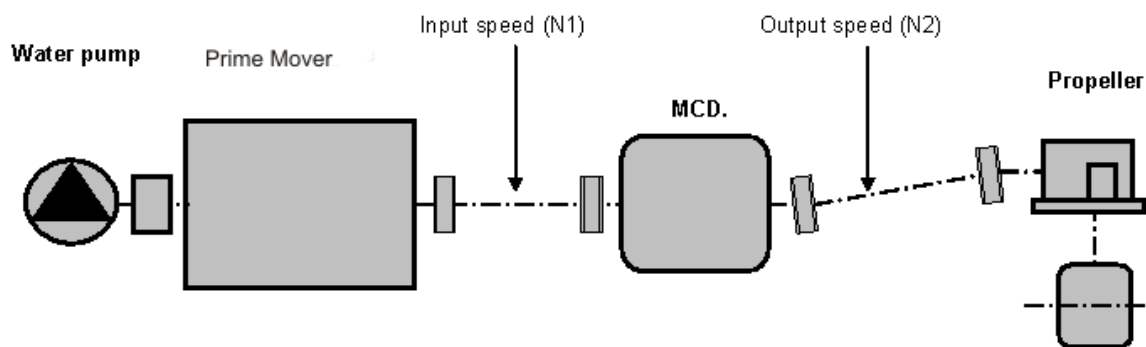


Figure 169. Usual Installed Configuration

Coupling to Engine and Load

This transmission is supplied with input and output shafts equipped with double tapered bearings, but the couplings used must not generate too abnormal radial or axial loads. Alignment must be performed in accordance with the instructions for the type of coupling used. Take into account a thermal expansion of 0.3 mm in center line height when the unit is at operating temperature.

The MCD must be firmly fixed to a base using M18 x 24 bolts. Alignment can be facilitated by using the jacking screws in each foot. Grouting in with an epoxy resin is also authorized.

Alignment

Proper alignment will maximize the life of the MCD, particularly of the bearings. This applies to MCD's both with flexible and with non-flexible coupling. Even slight misalignment may very rapidly cause damage to the bearings.

Take care to insure even loading on the four mounting pads. Any unevenness in the base, can be compensated by metal shims. Proper shimming will avoid distortion which can improperly load the bearings.

The input and output flanges must be properly aligned before installation of the clamping capscrews.

Flange Alignment Procedure

Slowly turn coupling through 360° and note the maximum deflection of dial gage pointer.

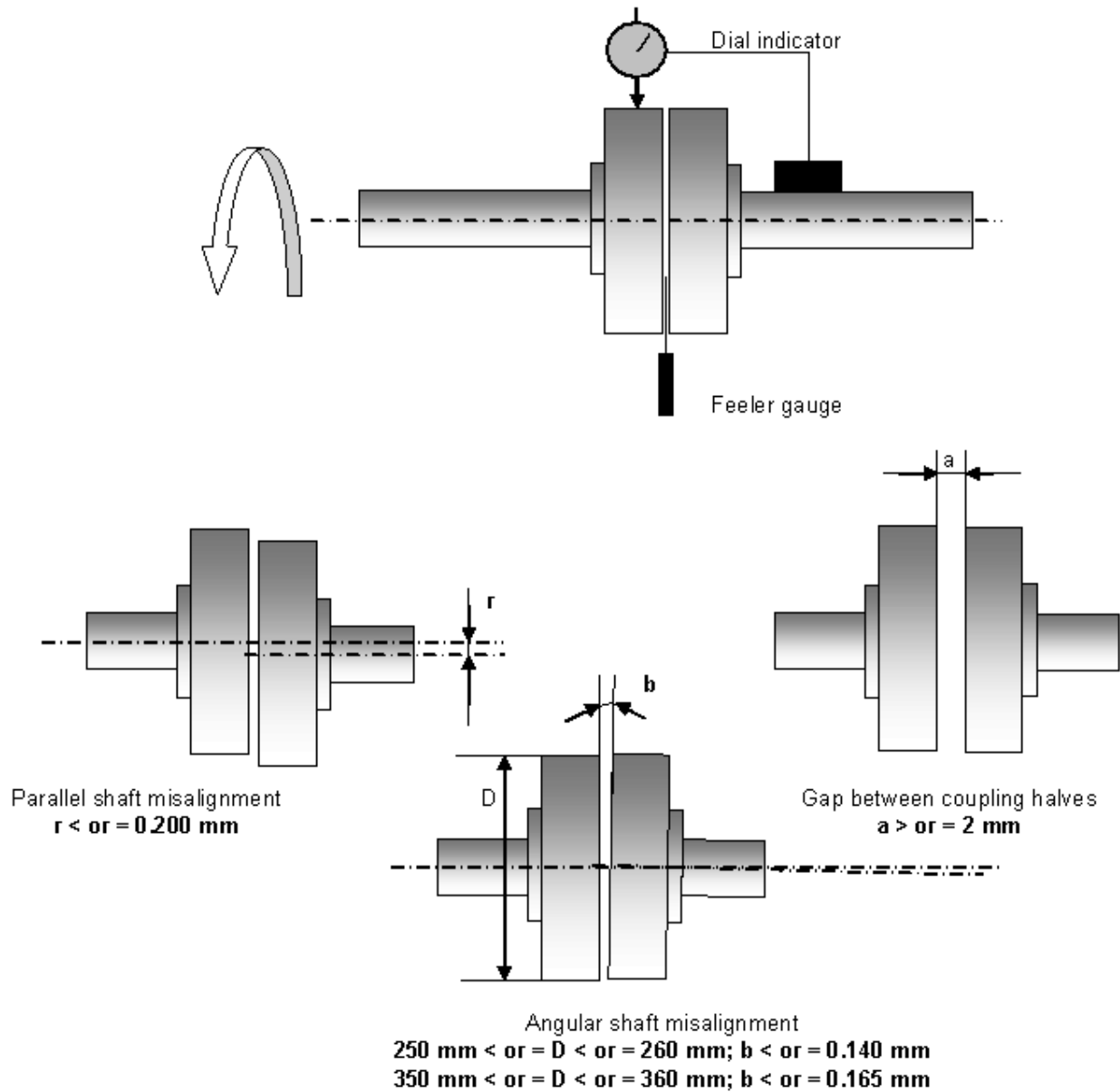


Figure 170. Check Deflection of Coupling

Measure angular misalignment along the entire circumference with a feeler gauge. If a dial indicator is not available or if this instrument is difficult to install, please proceed as follows:

1. Insert a 0.002" (0.05 mm) feeler gauge between the flanges of the coupling. Move the feeler gauge completely around the coupling.
2. Rotate the flange coupling to 90°, 180°, and 270° positions. Move the feeler gauge completely around the coupling in each successive position. If alignment is correct, the feeler gauge fits snugly with the same tension all around the flange coupling. If the gap varies during rotation, then further alignment is necessary, or the MCD and shaft couplings should be checked for improper face run-out. The clearance must be less than 0.002" (0.05 mm).
3. During the process of securing alignment, it may be necessary to shift the prime mover many times. When it becomes apparent that the alignment is acceptable, mark the locations and drill the holes for the lag studs. Then with the final alignment completed, secure the prime mover and MCD in place, using steel or hardwood shims as necessary.
4. Recheck the alignment and, if satisfactory, bolt the coupling together.

Although it is not necessary to align a flexible coupling as accurately as a solid coupling, the closer it is in the initial alignment, the more vibration free it will be.

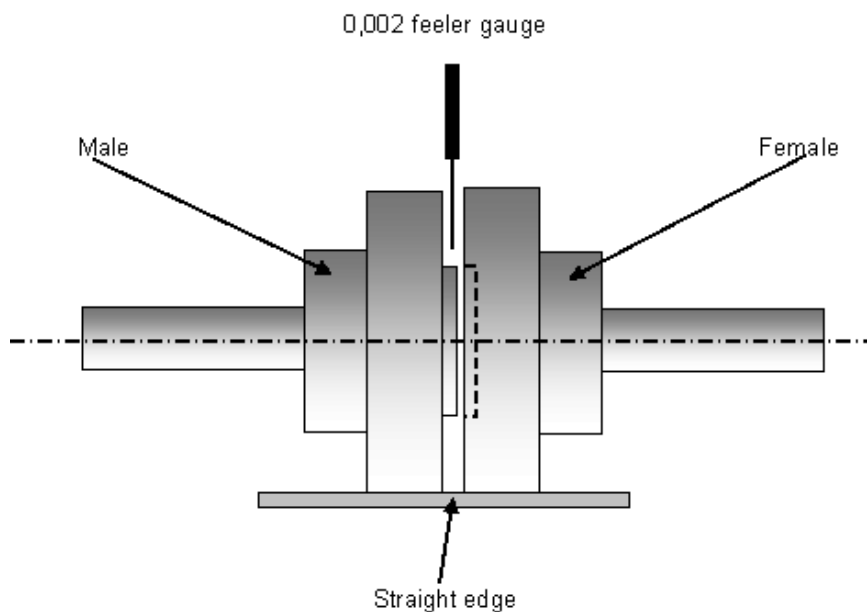


Figure 171. Move Feeler Gauge Around Entire Circumference

Plumbing for Cooling

The MCD must be connected to a remote mounted oil to water cooler. To enable this, the MCD is equipped with two 3 inch SAE J518 bolted flanges.

The oil temperature must remain relatively constant. Since the heat generated by friction in the MCD is not constant, the heat exchanger is equipped with a three-way thermostatic valve. This valve by-passes the cooler when oil temperature is insufficient.

On the Oil Side

Connections are 1 1/2" BSP thread. Pipes must have an internal diameter of 1 1/2" or 38 mm minimum, and be in a material compatible with hot mineral oil (operating temperature 71°C - 79°C). Total pressure drop in the lines should not generate back pressure of more than 2 Bar (25 Psi) at the MCD Outlet. Take care to avoid dirt inside the oil pipes.

On the Water Side

The cooler is equipped with two BS 4504-16/2 bolted flange connections, outside diameter 5.9" (150 mm). Maximum water pressure admissible at inlet is 5 Bar. Water connections must be such that flow is opposite to oil flow. Cooling is obtained by a fresh water circuit from a keel cooler.

Oil Filling Procedure

The MCD is supplied with an oil filling air breather. The oil level can be checked on a sight glass on the side of the unit. Oil used must be to the following specification:

AUTOMATIC TRANSMISSION FLUID DEXRON II TYPE; The oil must pass the transmission fluid ALLISON C4 or CATERPILLAR T02 specifications.

With the prime mover stopped, the MCD must first be filled to the maximum level mark on the sight glass, but the oil level must be finally adjusted to the middle of the gauge when the prime mover is running.

Be sure that all external pipework and the MCD cooler are completely purged of air. The oil sump is provided with a 3/4" drain valve.

Oil quantity: 110 Liters (MCD 3000-1 to 6).

Electrical Wiring

Drawings

PX-10325	Electronic controller installation
PX-103299	Wiring diagram without any classification requirement
PX-10310	Wiring diagram with A.U.T. classification

All the explanations given hereafter will refer to the PX-10310 wiring diagram.

Operating Voltage

The electronic controller can be supplied in two different ways according to the user's requirements:

DC power supply:	24 Vdc (2 A max)	See drawing PX-10310.
AC power supply:	18 Vac (2 A max)	See drawing PX-10310.

Both power supplies can be connected at the same time.

Setpoint Signal Adjustment

Control Lever Mode

The joystick potentiometer must be connected to intermediate terminals (I.T.) 24, 25 and 26. See drawing PX-10310. When using the control lever mode, make sure there is no link between 35 and 38 on the I.T.

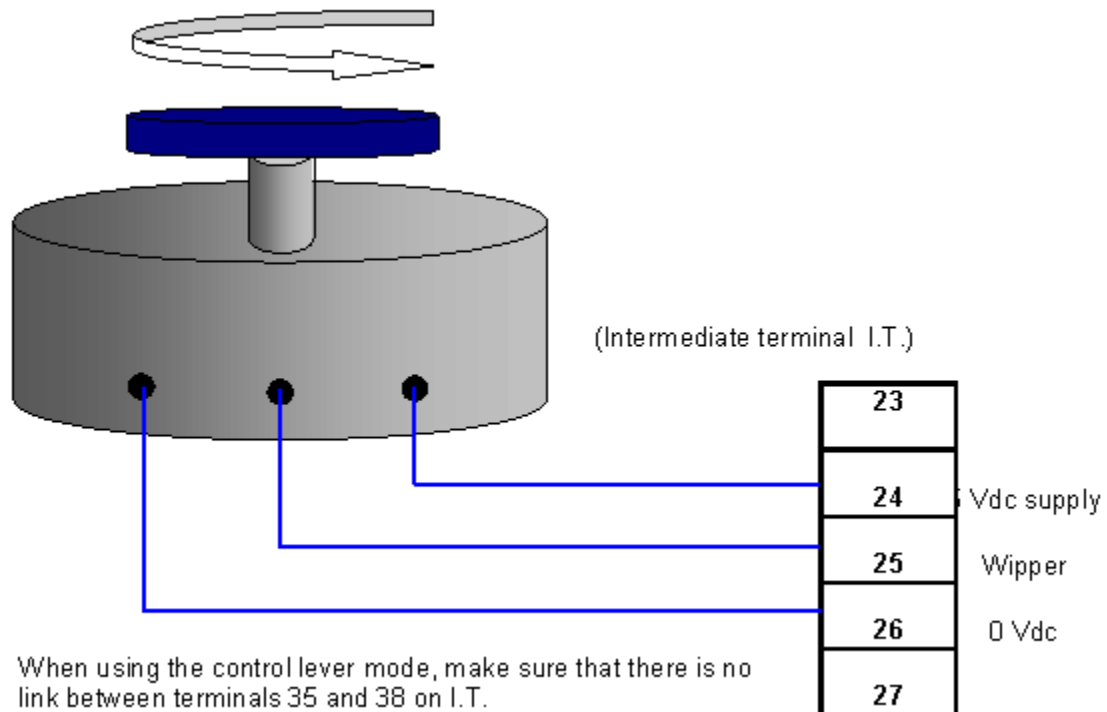


Figure 172. Potentiometer Connections

Remote Control Mode

The set point signal can be provided by a DC analog signal.

Voltage signal: 0.200 Vdc to 5.00 Vdc.
Current signal : 4.00 mA to 20.00 mA.

Connect the negative to terminal 16 and the positive to terminal 15 on intermediate terminal I.T. When a remote setpoint is used, make sure that terminals 35 and 38 on I.T. are linked.

Feedback Signal (Output Speed Signal)

The feedback is delivered by a magnetic speed sensor and is connected to terminals 13 and 14 on the I.T. Sine wave signal is in Hz.

Analog Sensors and Servo-valve

Oil Temperature Sensor

The oil temperature sensor is connected to terminals 29 and 30 on the I.T. via the junction box (J.B.). This sensor has an impedance of about 600 Ohms at 77°F (25°C).

Control Pressure Sensor

The control pressure sensor is connected to terminals 27 and 29 on I.T. This sensor has a resistance of about 10 Ohms at atmospheric temperature and at 25°C.

Servo-valve

The UCD output speed is controlled by a proportional servo-valve, which provides a control pressure proportional to the control current. This servo-valve impedance is about 20 Ohms and is connected between terminals 55 and 56 on the I.T.

Auxiliary Speed Sensor

In addition to the basic speed indications provided on the electronic display PX-10002, auxiliary speed indicators can be installed as an option. They must be connected to terminals 18, 19 and 20 on I.T. where the signals are available.

Set point signal : 0.00 Vdc to 5.00 Vdc between terminals 18 and 19.
Feedback: 0.00 Vdc to 5.00 Vdc between terminals 19 and 20.



Special Tools

List of Special Tools

The following pages include the special tool drawings that are specific to this model.

- ☐ S.K.F. Hydraulic Pump
- ☐ PB-3060 Oil Injector
- ☐ PX-7640C Flange Mounting Instructions
- ☐ D-1962 Connection Nipple
- ☐ PD-2991A (3 pages)
- ☐ PB-3216 Flange Mounting Adapter
- ☐ PD-3166 Clutch Mounting Tool (2 pages)
- ☐ PM-8166 Sealed Cam Follower
- ☐ PB-3157 Pressure Plate
- ☐ PB-3156 Centering Cone
- ☐ PA-3153 Tie Rod Nut
- ☐ PB-3154 Tie Rod
- ☐ PD-3163 Roller Rail
- ☐ PD-3159 Roller Rail Support
- ☐ PA-3158 Guide Block

S.K.F. Hydraulic Pump

Specifications

Pmax: 173 Mpa, or 1724 bar, or 25000 psi

Reference (S.K.F. Part No.)

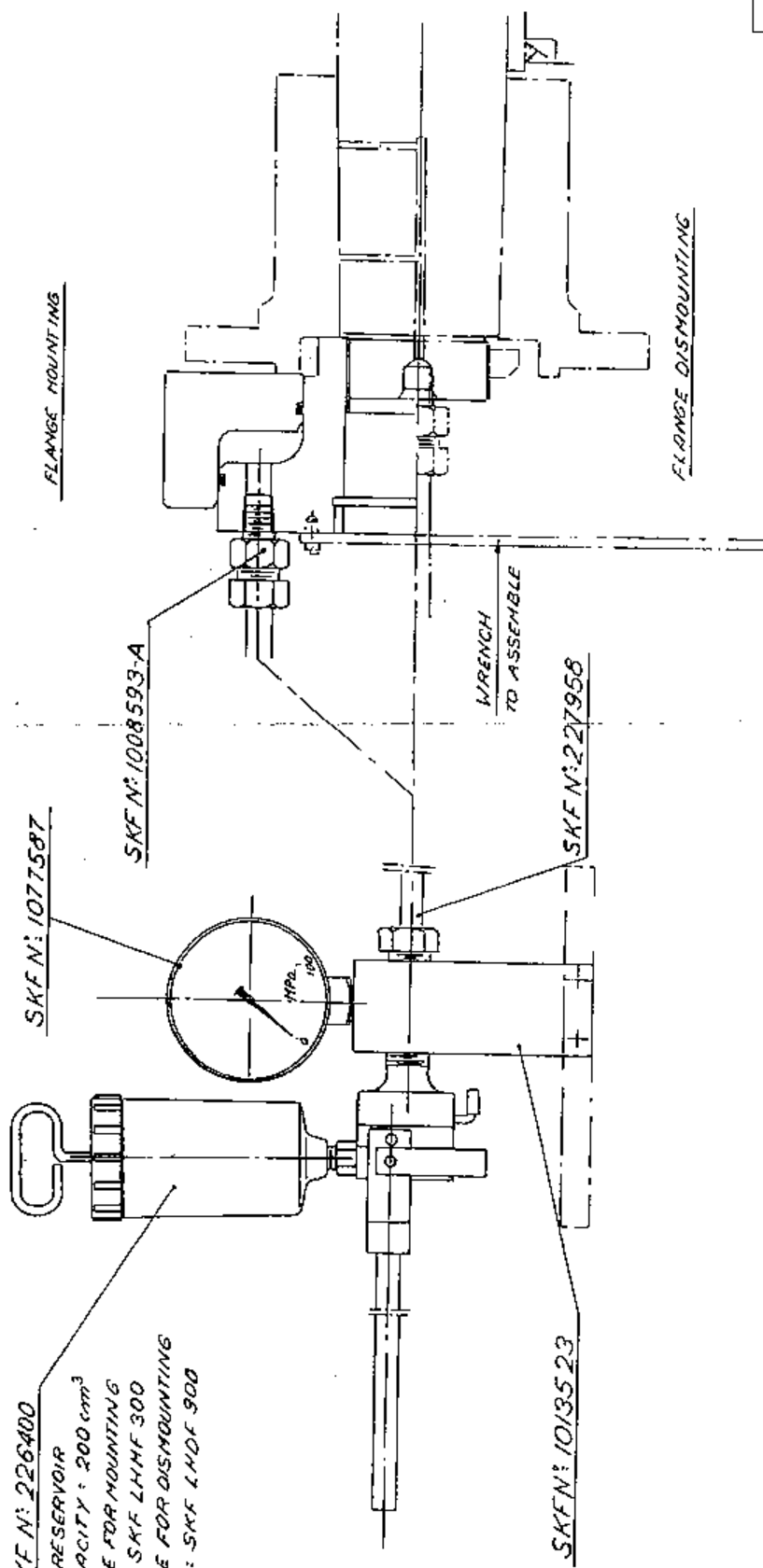
Tank: 226400
Gauge: 107787
Valve Block: 1013523
Fitting: 227958
Fitting: 1008593-A

Hydraulic Oil Injector: 1012783 (Twin Disc AD-1962)
Hydraulic Hose, Flexible
Locking Nut screws on the shaft



Figure 173. Spacer

MPQ	145	10
PSI	0089	069
BAR	10	145



SKF N° 226400
OIL RESERVOIR
CAPACITY : 200 cm³
USE FOR MOUNTING
OIL : SKF LHM 300
USE FOR DISMOUNTING
OIL : SKF LHM 900

DIMENSIONAL TOLERANCE UNLESS SPECIFIED
MACHINED SURFACES ± 0.1
ANGULAR LOCATION OF DRILLED HOLES ± 0.08
ANGULAR LOCATION BETWEEN CIRCLES DRILLED HOLES ± 0.03
MACHINED ANGLES ± 2° EXCEPT CHAMFERS
CASTING FINISH MIN. MAX. :

FOR MOUNTING & DISMOUNTING SEE PX 78406A

SIMILAR TO PART NO.	CH. NO.	DATE	UY	SYM.	WAS	CH. NO.	DATE	UY	SYM.	WAS	CH. NO.	DATE	UY

MATERIAL	HEAT TREAT	SURFACE TREATMENT	WEIGHT	ROUGH	FINISHED	DATE	UY	SYM.	WAS	CH. NO.	DATE	UY

TWIN DISC INTERNATIONAL
Société Anonyme
NIVELLES - BELGIUM
PB-3060

MOUNTING:

- a) REMOVE ALL BURRS OR SCRATCHES AND CLEAN PROPERLY. BEFORE MOUNTING, CHECK VISUALLY FOR A PERFECT FIT OF MALE AND FEMALE TAPER LENGTH.
- b) AFTERWARDS, DEGREASE PROPERLY BOTH SURFACES IN CONTACT BY MEANS OF SOLVENT (METHYLCHLORIFORM) OR TRICHLOROETHANE AND DRY THOROUGHLY THESE SURFACES.
- c) PLACE FLANGE ON SHAFT JUST CLOSE WITHOUT PRESSURE, ASSEMBLE THE 4 PARTS OF TOOLING AGAINST FLANGE AND CONNECT OIL PRESSURE SYSTEM TO TOOLING. *
- d) MEASURE "Y" DIMENSION ON TOOLING BEFORE OIL PRESSURE IS APPLIED, THEN APPLY A PRESSURE OF:
 - MIN. 5700 P.S.I. - 39.9 MPa WHICH MUST CORRESPOND TO A MIN. FLANGE ADVANCEMENT OF .100
 - MAX. 8100 P.S.I. - 55.8 MPa WHICH MUST CORRESPOND TO A MAX. FLANGE ADVANCEMENT OF .140
- e) BOTH CONDITIONS TO BE CONSIDERED TOGETHER. CHECK CLEARANCE AT "A"

DISMOUNTING:

- SCREW THE LOCK NUT (AS SHOWN) ON SHAFT END UP TO .18 AXIAL CLEARANCE WITH FLANGE TO AVOID PROJECTION OF FLANGE, THEN CONNECT OIL PRESSURE SYSTEM * TO 3/8-19 B.S.P. THREAD IN SHAFT AND APPLY PRESSURE TO DISASSEMBLE TAPER JOINT.

* SEE PB-3060 FOR TYPICAL TOOLING

① ② ③ ④ SEE PD-2991-A, AND PB-3216

SYM.	WAS	CH. NO.	DATE	BY	SYM.	WAS	CH. NO.	DATE	BY

ROUGH	FINISHED

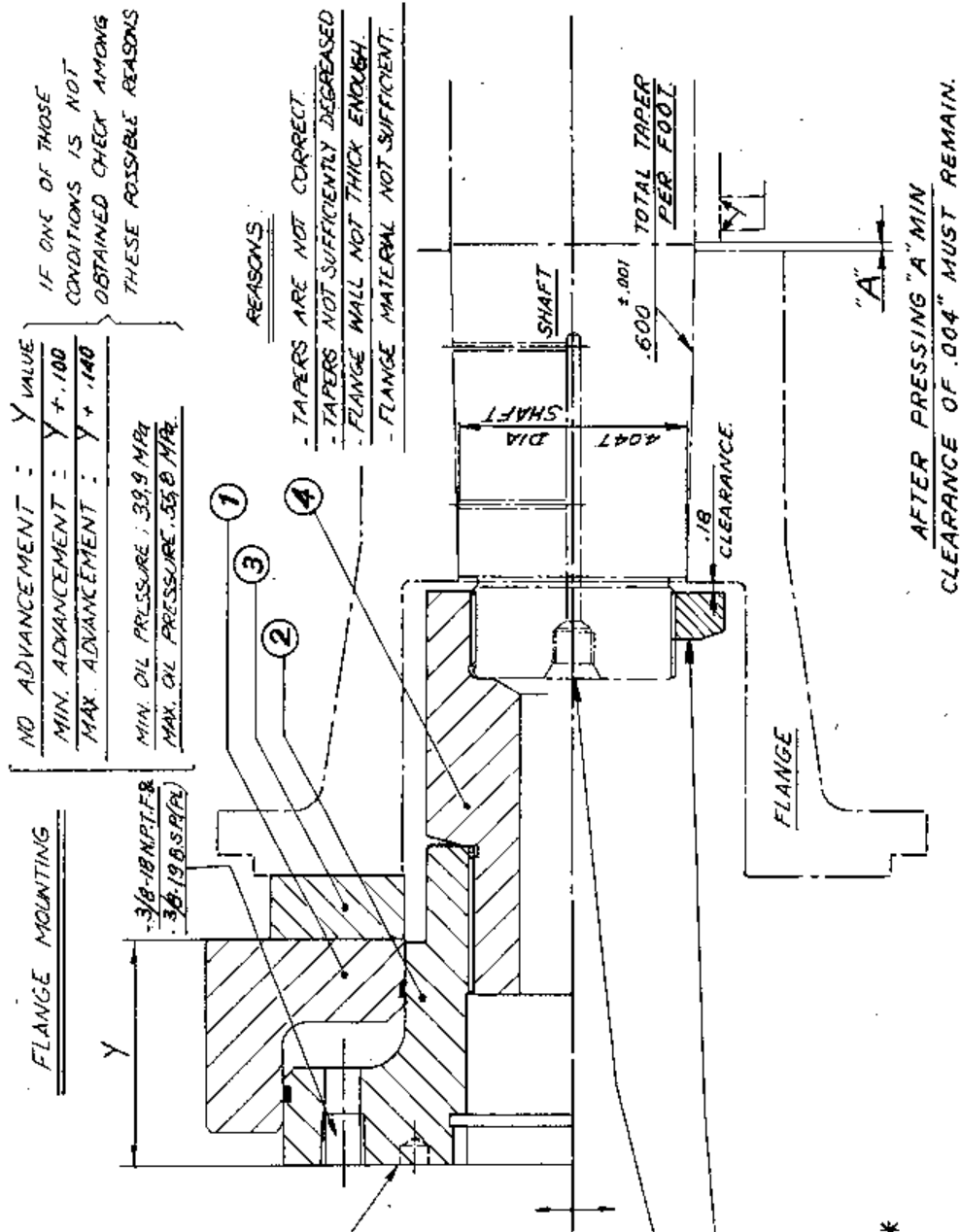
ASSEMBLY NO.	MODEL NO.
PX-1000-N-P-R-5	MCD-3000
NAME	INSTRUCTIONS, FLANGE MOUNTING

DATE	SCALE	DRAWN	CHECKED	APPROVED
20/04/87	1:1	J.D.		

TWIN DISC INTERNATIONAL
Société Anonyme
NIVELLES - BELGIUM

PX-7640-C

ISSUED
TWIN DISC INTERNATIONAL S.A.
- 9 -04- 1988
TECHNICAL OFFICE
NIVELLES - BELGIUM



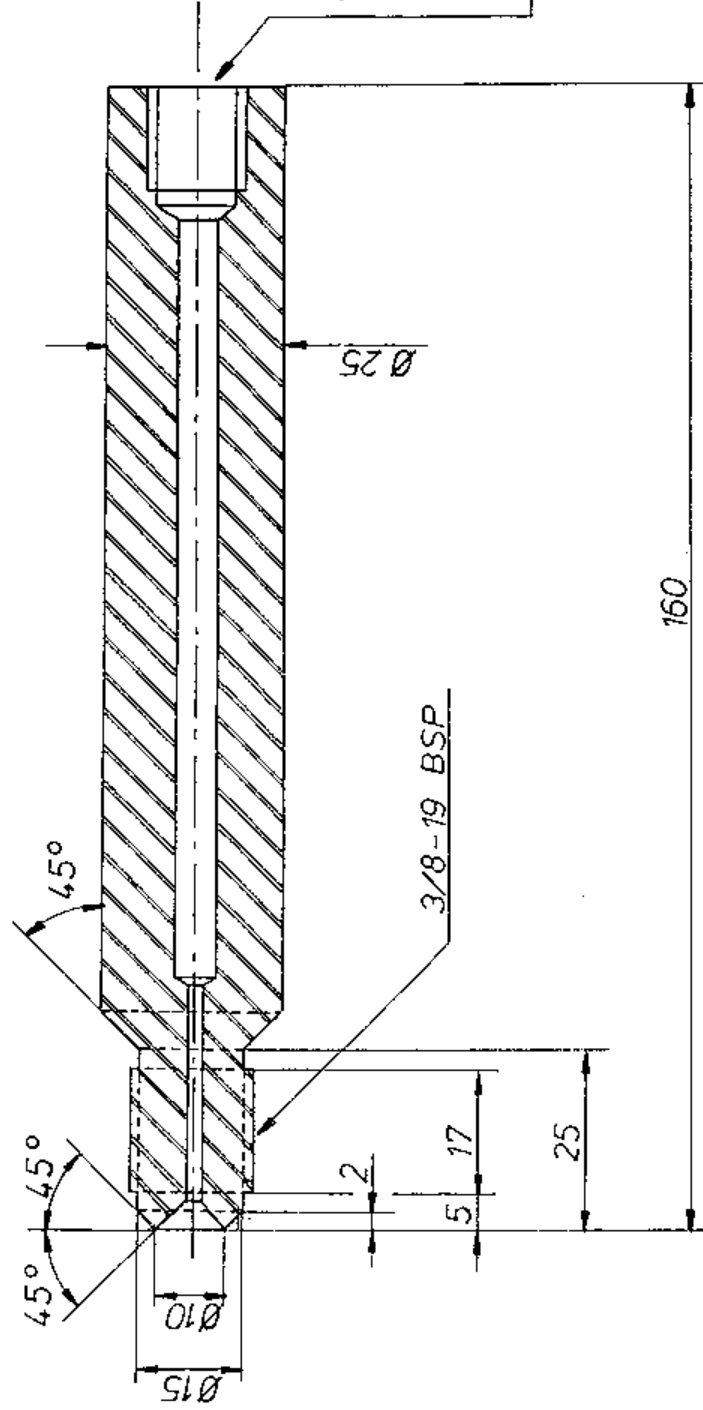
AFTER PRESSING "A" MIN
CLEARANCE OF .004" MUST REMAIN.

NO ADVANCEMENT : Y VALUE
MIN. ADVANCEMENT : Y + .100
MAX. ADVANCEMENT : Y + .140
MIN. OIL PRESSURE : 39.9 MPa
MAX. OIL PRESSURE : 55.8 MPa

REASONS:

- TAPERS ARE NOT CORRECT
- TAPERS NOT SUFFICIENTLY DECREASED
- FLANGE WALL NOT THICK ENOUGH
- FLANGE MATERIAL NOT SUFFICIENT

IF ONE OF THOSE
CONDITIONS IS NOT
OBTAINED CHECK AMONG
THESE POSSIBLE REASONS



- 3 mm DIA DRILL THRU
- 6 mm DIA DRILL, 125 mm DEEP
- 11.8 mm DIA DRILL, 17 mm DEEP
- 1/4-19 BSP TAP, 15 mm DEEP

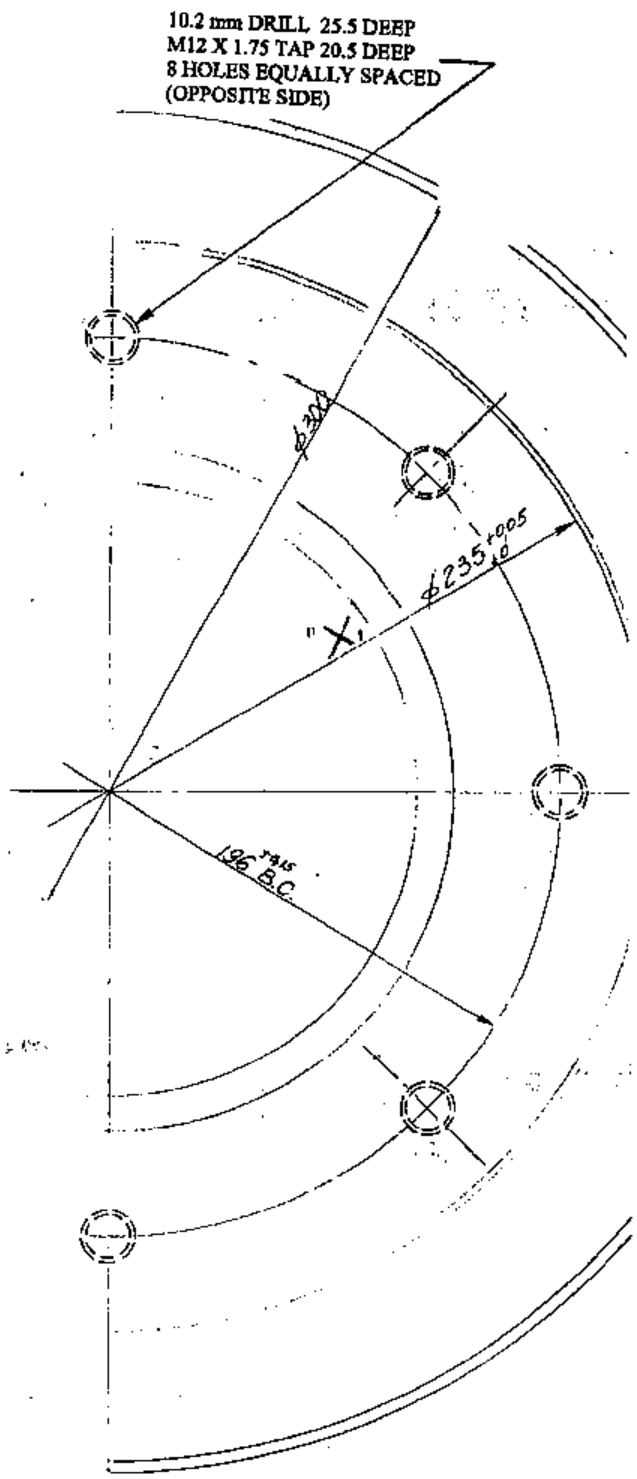
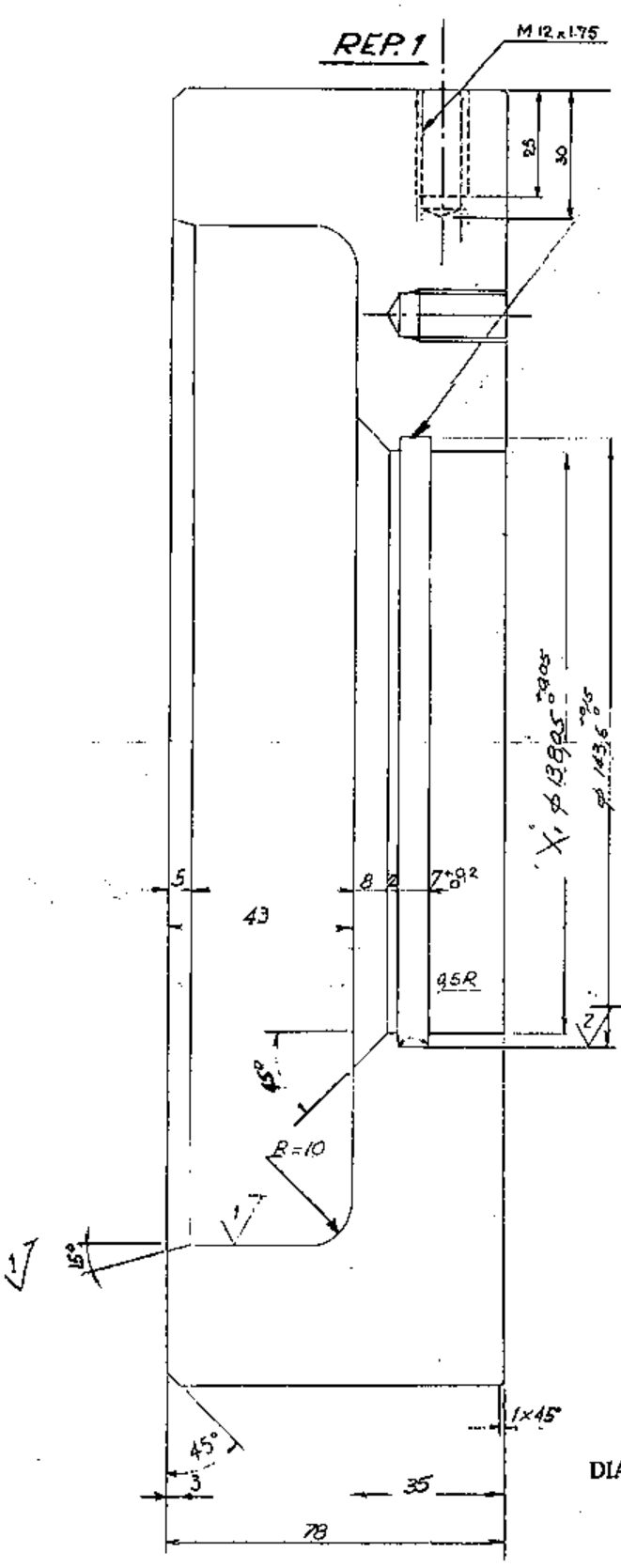
Only for hydraulic
pump 728619 from
SKF

SIMILAR TO PART NO	SKF part n° 1012783 (short)	FIRST USE ASSEMBLY NO. MCD 3000 MODEL NO.	UNLESS OTHERWISE SPECIFIED USE ± .01 ON DIMENSIONS	
			MATERIAL Steel Mo40	HEAT TREAT
			SURFACE TREATMENT	WEIGHT ROUGH FINISHED
				DATE/JAN. 92
				SCALE 1=1mm
				DRAWN E.G.
				CHECKED

TWIN DISC INTERNATIONAL
société anonyme
NIVELLES - BELGIUM
RC. NIVELLES 27008 TVA 400 358 293

D-1962

CONNECTION NIPPI F SKF

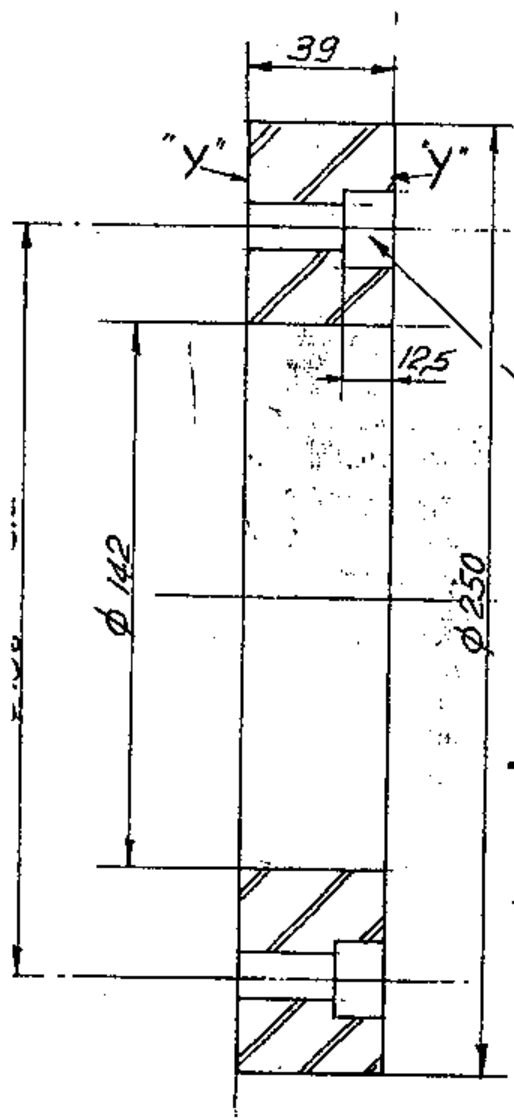


10.2 mm DRILL 25.5 DEEP
M12 X 1.75 TAP 20.5 DEEP
8 HOLES EQUALLY SPACED
(OPPOSITE SIDE)

DIAS MARKED X1 TO BE CONCENTRIC WITHIN 0.05 TIR

PD 2991 A
REP. 1

PD 2991A
REP. 2



- 13mm DRILL THRU
- 19mm COUNTERBORE
- 8 HOLES EQUALLY SPACED

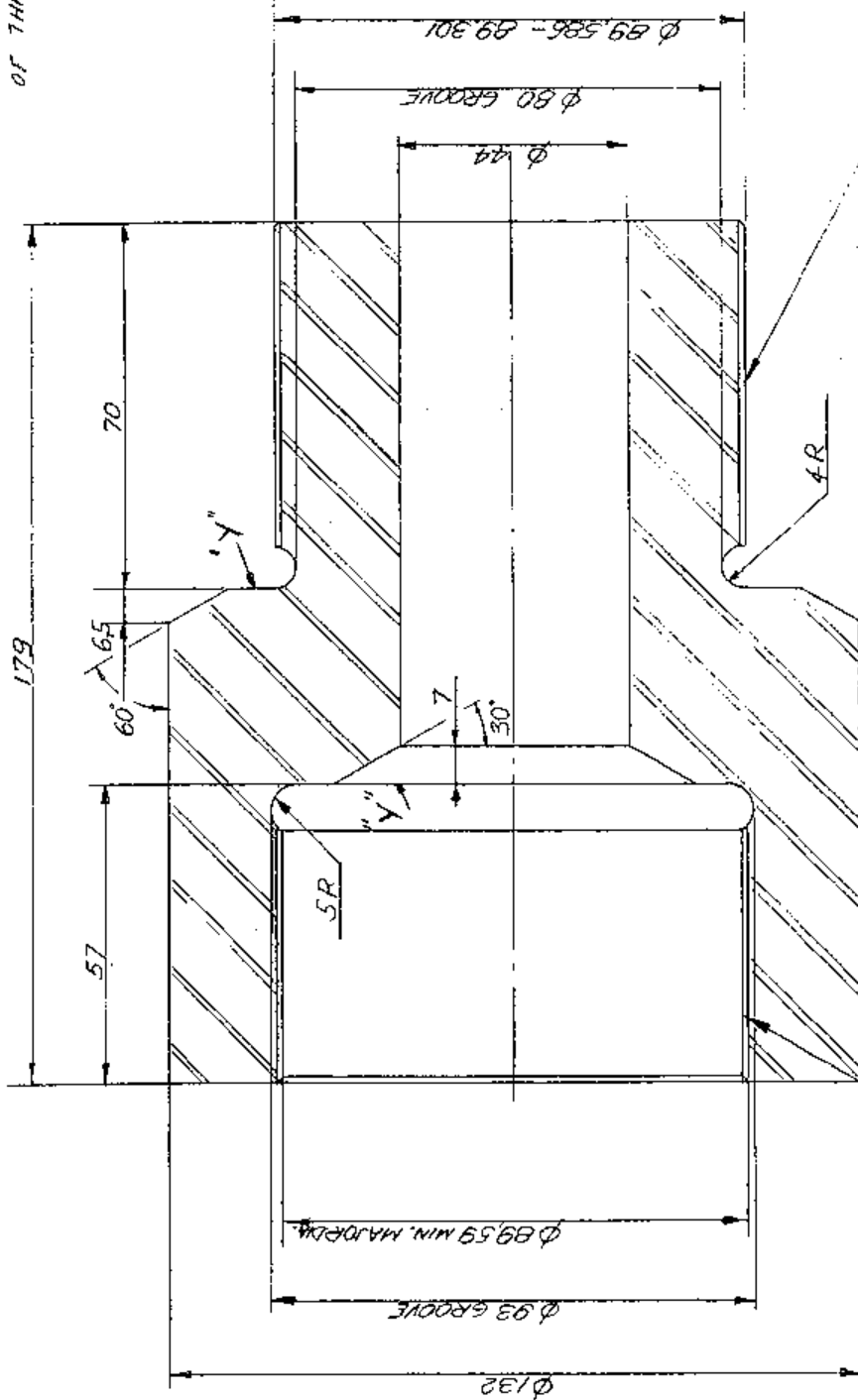
REP. 3

2 FACES "Y" TO BE PARALLEL
WITHIN 0,05 T.I.R

SCALE: 1/2

PD 2991 A
REP. 3

.2 FACES "Y" TO BE SQUARE WITH PITCH DIA
OF THREADS WITHIN .003 T.I.R.



- 88,212 - 88,024 PITCH DIA.
12 UNS THREAD (FOR N.18 NUT)

- MINOR DIA: 87.29 - 87.52 mm
- PITCH DIA: 88.21 - 88.40 mm
- NUMBER THDS PER INCH: 12 N.S. CLASS 3

ISSUED
TWIN DISC INTERNATIONAL S.A.
- 9 - 04 - 1998
TECHNICAL OFFICE
NIVELLES - BELGIUM

DIMENSIONAL TOLERANCE UNLESS SPECIFIED
MACHINED SURFACES ± .01
ANGULAR LOCATION OF DRILLED HOLES ± .005
ANGULAR LOCATION BETWEEN CIRCLES DRILLED HOLES ± .003
MACHINED ANGLES ± 2° EXCEPT CHAMFERS
CASTING FINISH MIN MAX

OTHER PARTS OF TOOLING SHOWN ON: PD-2991A

ART NO.	CH NO.	DATE	BY	SYM.	WAS.	CH NO.	DATE	BY
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MATERIAL: STEEL 42CrMo4 OR BETTER	HEAT TREAT TO 32 - 36 Rc	DATE: 9 FEB 97
ASSEMBLY NO. PX-7640C	FIRST USE MODEL NO. MCD-3000	SCALE: 1" = 1"
NAME ADAPTOR, FLANGE MOUNTING	WEIGHT ROUGH	DRAWN: V.R.
	FINISHED	CHECKED
		APPROVED

TWIN DISC INTERNATIONAL
Société Anonyme
NIVELLES - BELGIUM
PB-3216

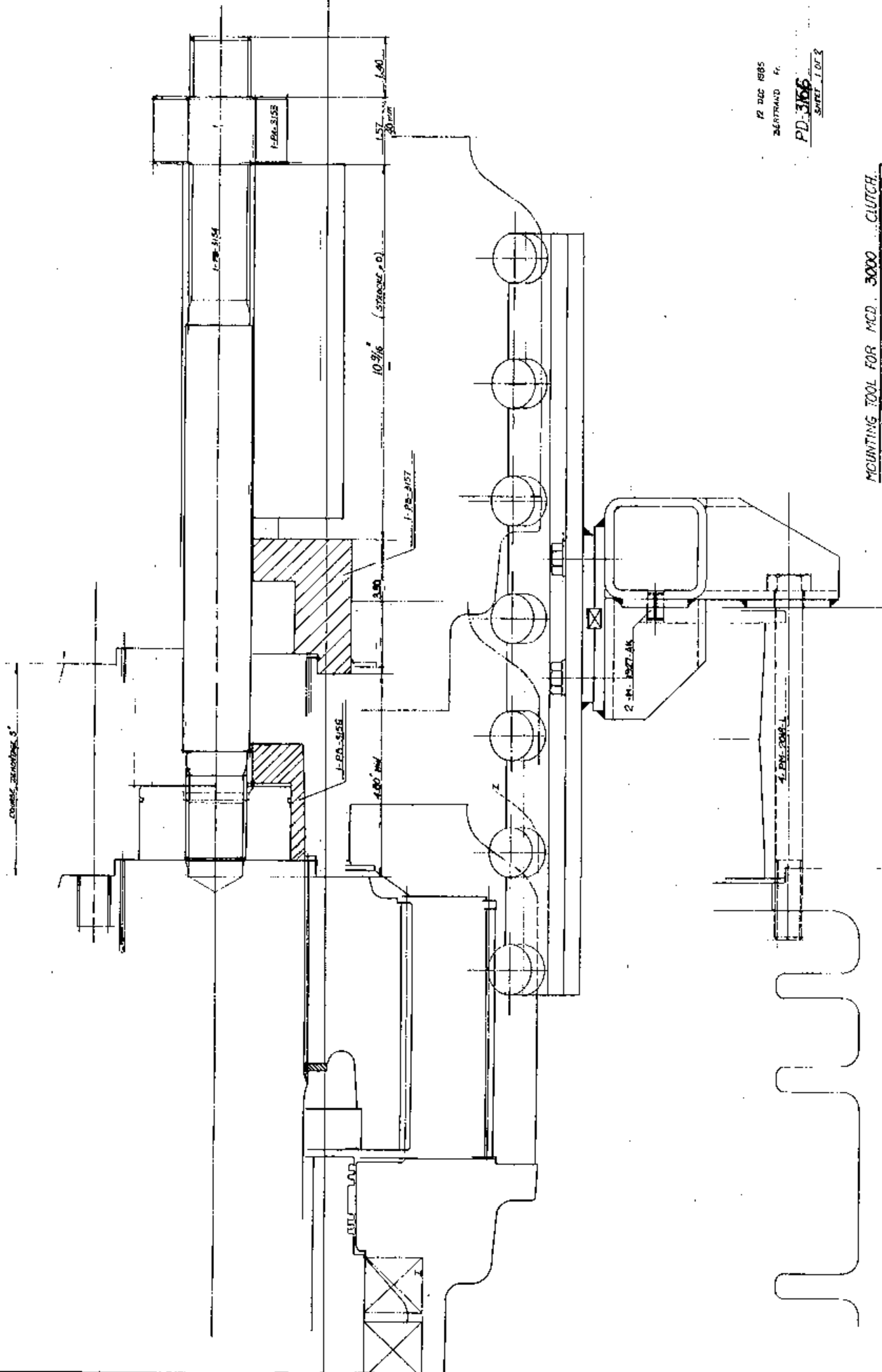
12 DEC 1985
BERTRAND F.

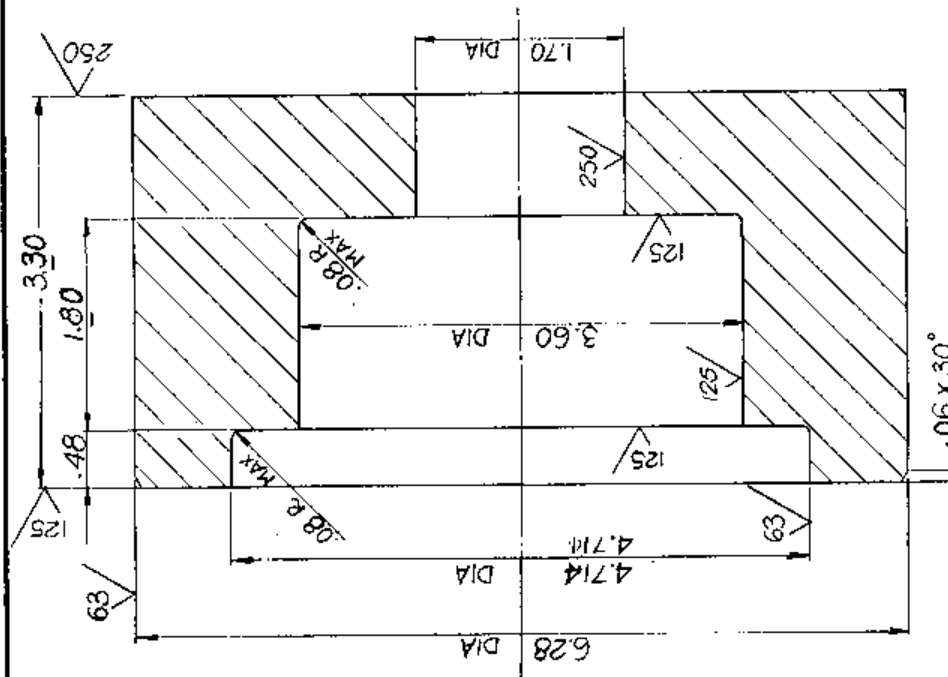
BERTRAND R.

PD-356
PAGE 1 OF 2

SUPER 1 OF 2

MOUNTING TOOL FOR MCD, 3000 ... CLUTCH.





SECTION AA

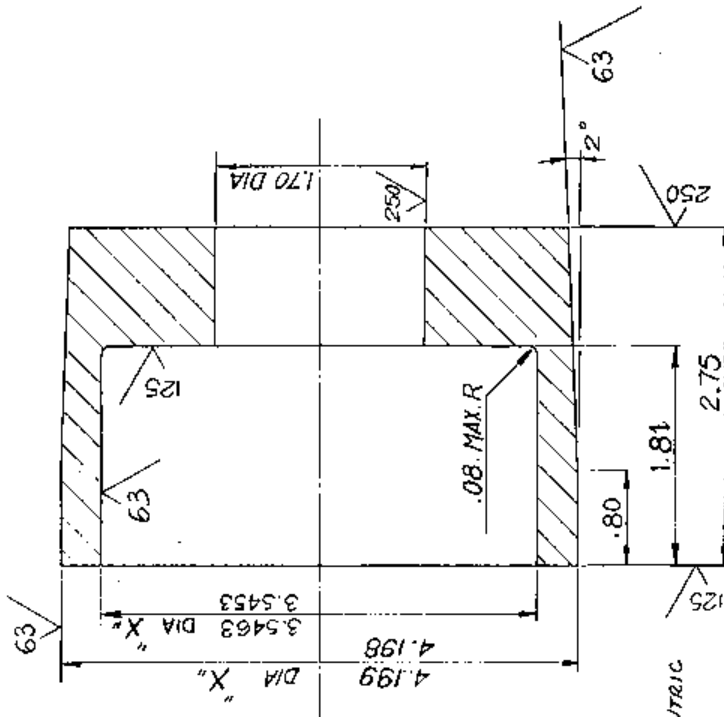
SIMILAR TO
PART NO.

SYM.	WAS	CH. NO.	DATE	BY	SYM.	WAS	CH. NO.	DATE	BY

DIMENSIONAL TOLERANCE UNLESS SPECIFIED
 MACHINED SURFACES $\pm .01$
 ANGULAR LOCATION OF DRILLED HOLES $\pm .005$
 ANGULAR LOCATION BETWEEN CIRCLES DRILLED HOLES $\pm .00$
 MACHINED ANGLES $\pm 3^\circ$ EXCEPT CHAMFERS
 CASTING FINISH MIN. MAX. :

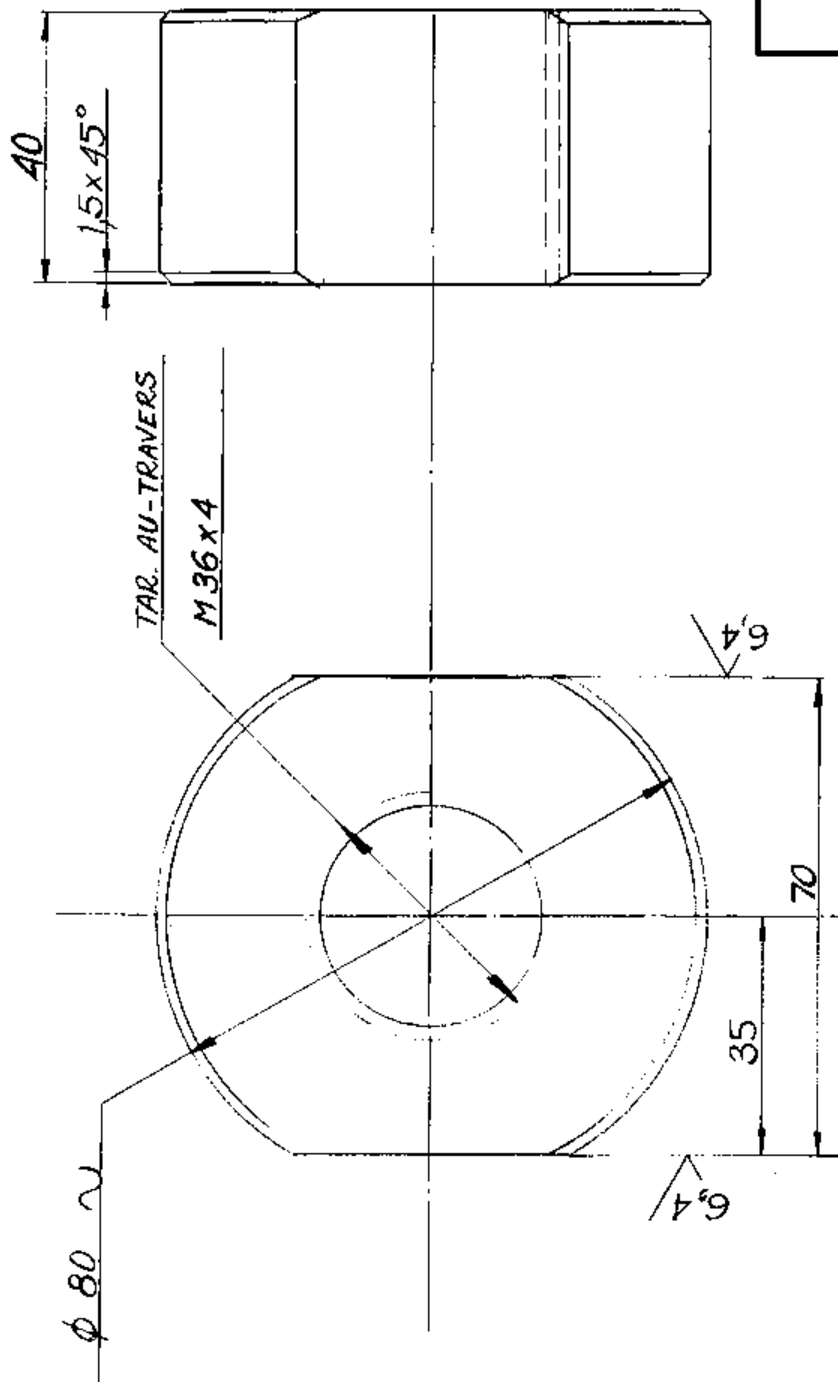
SURFACE TREATMENT	MATERIAL	HEAT TREAT
ROUGH	DIN CK 45	
WEIGHT	FIRST USE	
FINISHED	MODEL NO.	
	ASSEMBLY NO.	
	PB-3157	
	NAME	
	PRESSURE PLATE	

TWIN DSC INTERNATIONAL
 Nivelles - Belgium
 PB-3157



SECTION AA

25.2 EXP.



TOUTES LES COTES SONT EN mm

SIMILAR TO PART NO	FIRST USE	ASSEMBLY NO. PD-3162	UNLESS OTHERWISE SPECIFIED USE $\pm .01$ ON DIMENSIONS	
—	MATERIAL	DIN 42CrMo4	HEAT TREAT	TRAITE A COEUR 35-38 HRC
—	SURFACE TREATMENT		WEIGHT	FINISHED
—			ROUGH	
—				DATE 6 DEC 85
—				SCALE 1" = 1"
—				DRAWN <i>John S</i>
—				CHECKED <i>/</i>
—				APPROVED
SYM.	WAS	CH. NO	DATE	BY

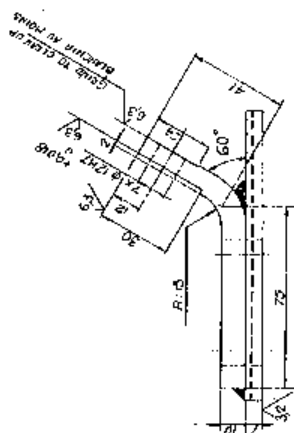
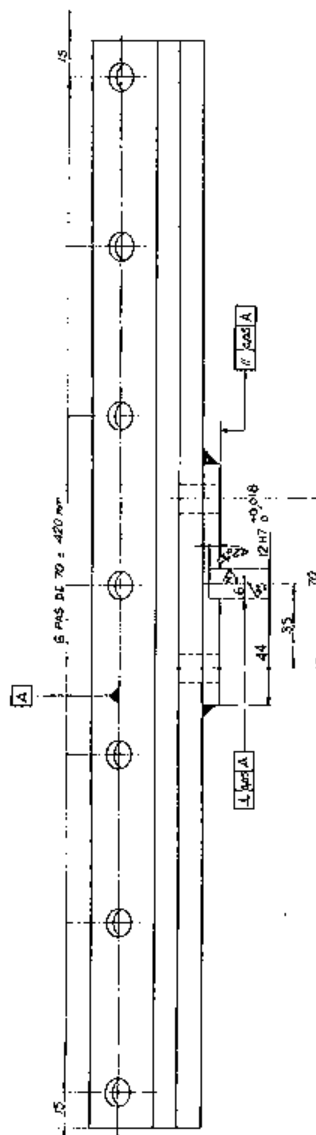
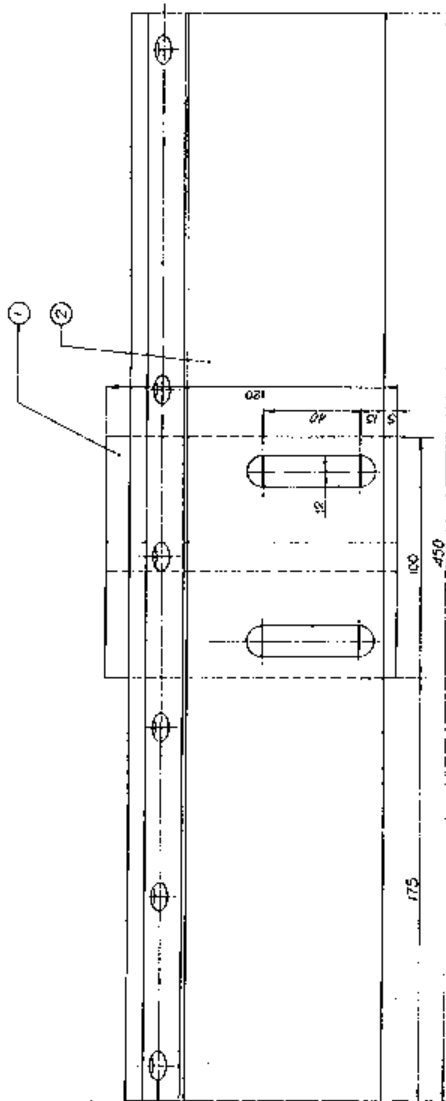
ECROU DE TIRANT

TWIN DISC INTERNATIONAL
société anonyme
WILLELS - BRUXELLES
NO. INVELOS 27008 TVA. 400 358 283

PA-3153

CUTTHRS - DECOUPAGES

- ① REQ'D - 800 x 10 x 4.5 S x 120 (ASTM - ST 37)
PIECE - PLATEAU - 800 x 10 x 4.5 (ST 37)
- ② REQ'D - 1000 x 10 x 4.5 S x 120 (ASTM - ST 37)
PIECE - TOUC - 1000 x 10 x 4.5 (ST 37)



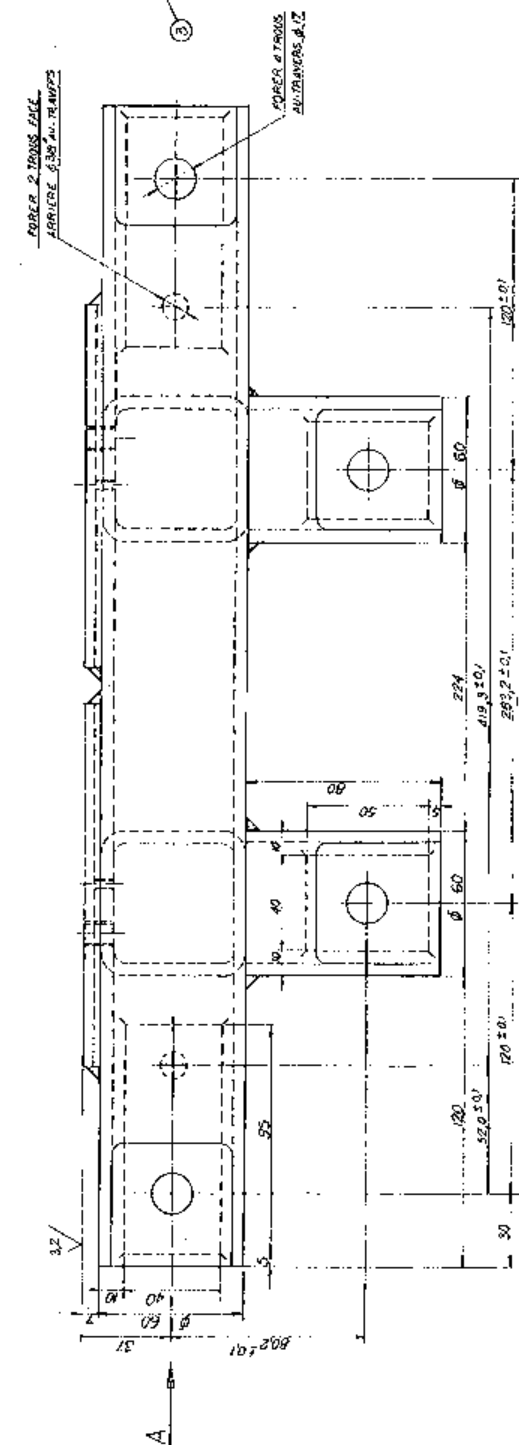
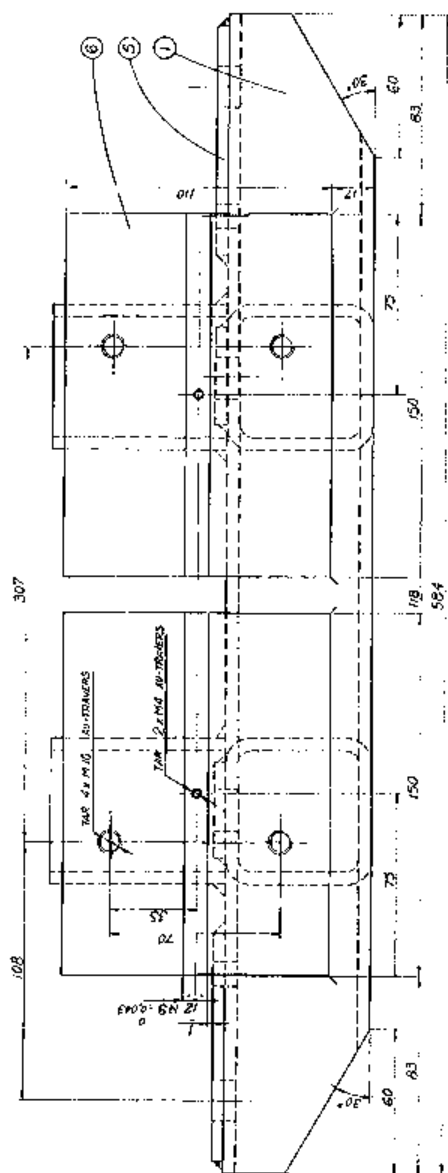
TOUS LES COTÉS SONT EN mm
TOUTES LES COTES SONT EN mm

THE BISC INTERNATIONAL	
INVESTMENT - BILDER	
PD-3161	
DATE	1987
ASSEMBLY No.	PD-3161
DATE	1987
ROOM	10000
REMARKS	

NO.	DATE	REVISION	BY	CHKD	APPD	REMARKS
1	1987	1				
2	1987	2				
3	1987	3				
4	1987	4				
5	1987	5				
6	1987	6				
7	1987	7				
8	1987	8				
9	1987	9				
10	1987	10				

DISCUSSION

1. TUBE CARRE 40-60-150p. - SCIER LGT 504 - 1PIECE - 5137
2. TUBE CARRE 60-60-50p. - SCIER LGT 80 - 2PIECES - 5137
3. TUBE CARRE 60-60-50p. - SCIER LGT 70 - 2PIECES - 5137
4. POUT LAMINE 40 5137 = 40x40-105-50-2PIECES
5. POUT LAMINE 40 5137 = 40x40-145-50-2PIECES
6. TOLE 60-60 - 5137 - 1PIECE - 10210 150 42 5137 - 82000



VUE SUIVANT A

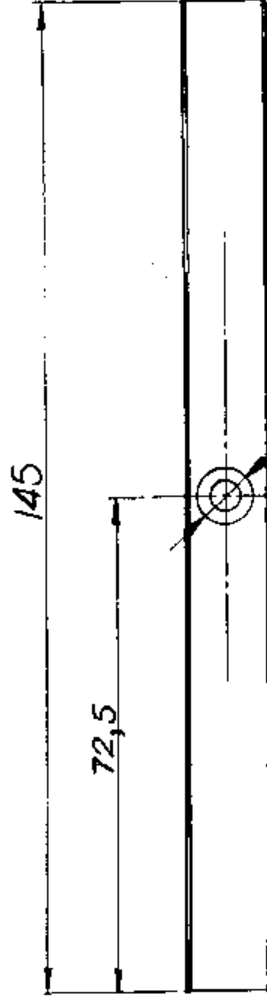
TOTALS LESS 50000000 3

WU NE JHS SNO/SNCHIT 527

A 40-year-old male, with a 10-year history of rheumatoid arthritis (RA), was admitted to the hospital with a 2-week history of progressive weakness and numbness in both lower extremities. He had no recent falls, trauma, or changes in bowel or bladder function. His medical history was significant for RA, treated with chronic low-dose prednisone (5 mg daily) and intermittent courses of higher doses (up to 20 mg daily) for flares. He had no other chronic medications. His family history was unremarkable.

TWIN DISE INTERNATIONAL 10000 10th Ave. N Minneapolis, MN 55412 TEL: 612-338-1111 FAX: 612-338-1112		TWIN TREAT 10000 10th Ave. N Minneapolis, MN 55412 TEL: 612-338-1111 FAX: 612-338-1112	
NATURAL AG. ST. 37		NATURAL AG. ST. 37	
SUPPORT RAIL ROLL- UP		SUPPORT RAIL ROLL- UP	
SUPPORT RAIL ROLL- UP		SUPPORT RAIL ROLL- UP	

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FORER Ø 4,5 AU-TRAVERS
CHAMBRER Ø 8 x 4,5 PROF.

BRISER LES
ARÊTES

TOUTES LES COTES SONT EN mm

SIMILAR TO PART NO		FIRST USE		UNLESS OTHERWISE SPECIFIED USE ± .01 ON DIMENSIONS	
ASSEMBLY NO.		MODEL NO.			
MATERIAL		AC. ETIRE A CALE		HEAT TREAT	
CK 45 - 12h9 x 8h11		SURFACE TREATMENT		WEIGHT FINISHED	
NAME		CALE DE GUIDAGE		DATE 10 DEC 85	
SYMBOL		WAS		SCALE 1" = 1"	
CH. NO.		DATE		DRAWN BY	
BY		APPROVED		CHECKED ✓	

TWIN DISC INTERNATIONAL
SOCIÉTÉ ANONYME
WAVELLES - BELGIUM
INC. WAVELLES 27008 TEL. 400 358 293

PA-3158

Engineering Drawings

List of Engineering Drawings

The following pages include the engineering drawings that are specific to this model. The engineering drawings included are listed below.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

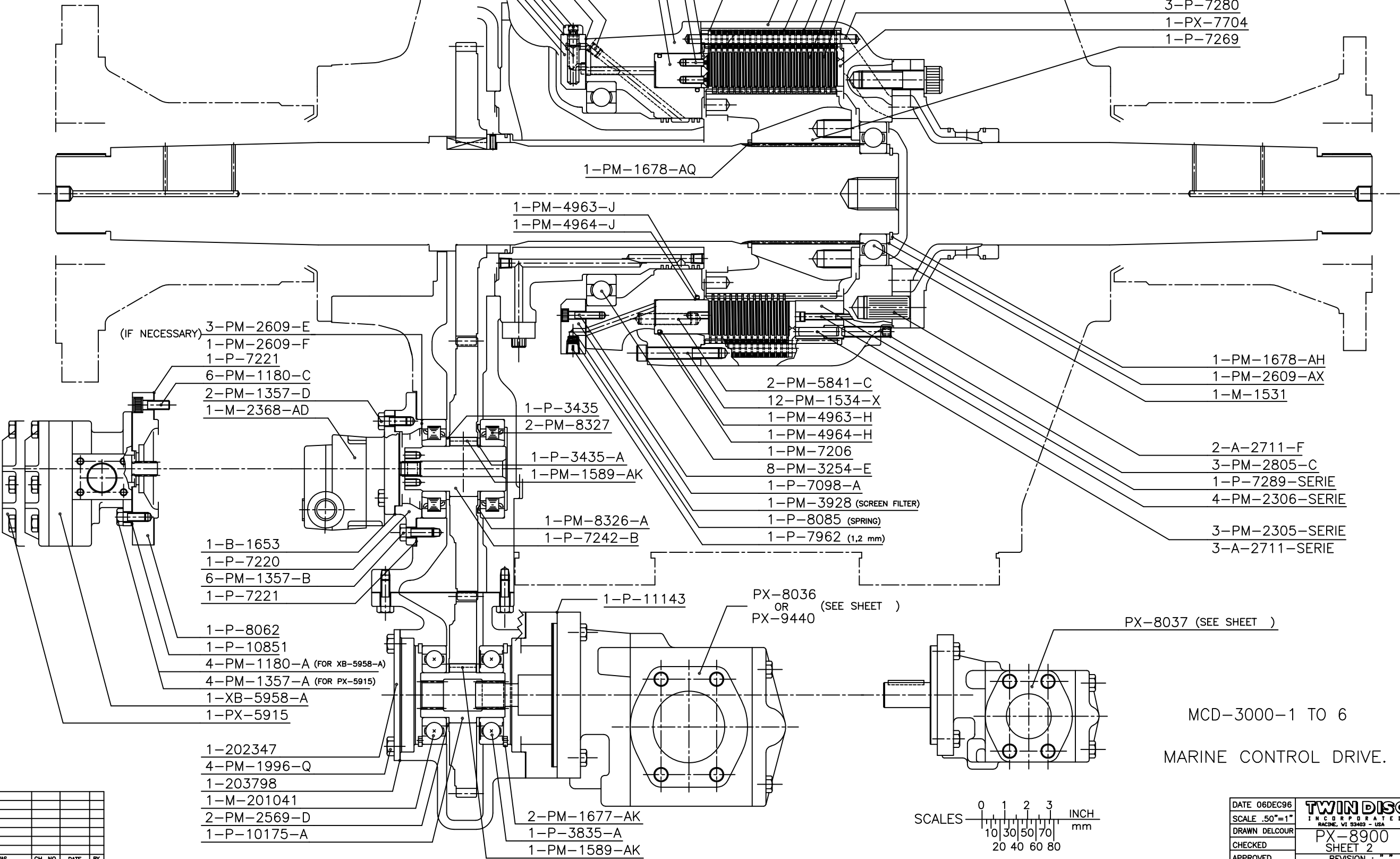
☐	PX8900-1	MCD3000 Cross Section
☐	PX8900-2	MCD3000 Cross Section
☐	PX8900-3	MCD3000 Input View
☐	PX8900-4	MCD3000 Valves
☐	PX8890-HU	MCD3000 Installation (Typical)
☐	PB2995-G	MCD3000 Hydraulic Schematic
☐	PX10310	MCD3000 Wiring Diagram
☐	PX10325	Microprocessor Group
☐	PX8225-M	Trailing Pump Electrical (Typical)
☐	PX11050	Auxiliary Pump Installation
☐	PX12280	Cooler
☐	PX9195	Cooler Schematic (Typical)

PISTON OMEGA		
NUMBER	R.P.M.	WEIGHT (Lbs)
P-10575	---	.01433
P-4622-B	2600-3000	.02675
P-4622-A	2200-2600	.03409
P-4622	1500-2200	.04310
P-4623	1000-1500	.05300
211582-D	850-1000	.06218
P-10521	700-850	.09138
P-10526	-700	.18735

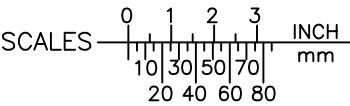
1-M-2051-F
 2-P-7209
 2-PM-2306-A
 1-P-3666
 1-P-4881
 PISTON OMEGA
 SEE CHART
 1-P-7098

3-P-7279
 6-PM-1455-B
 1-P-7088
 1-P-7277

3-P-7023-A
 1-P-7275
 66- P-7023 MAX.
 264-PM-7024-A MAX.
 22-P-8045 MAX.
 23-P-10890-A MAX.
 3-P-7280
 1-PX-7704
 1-P-7269

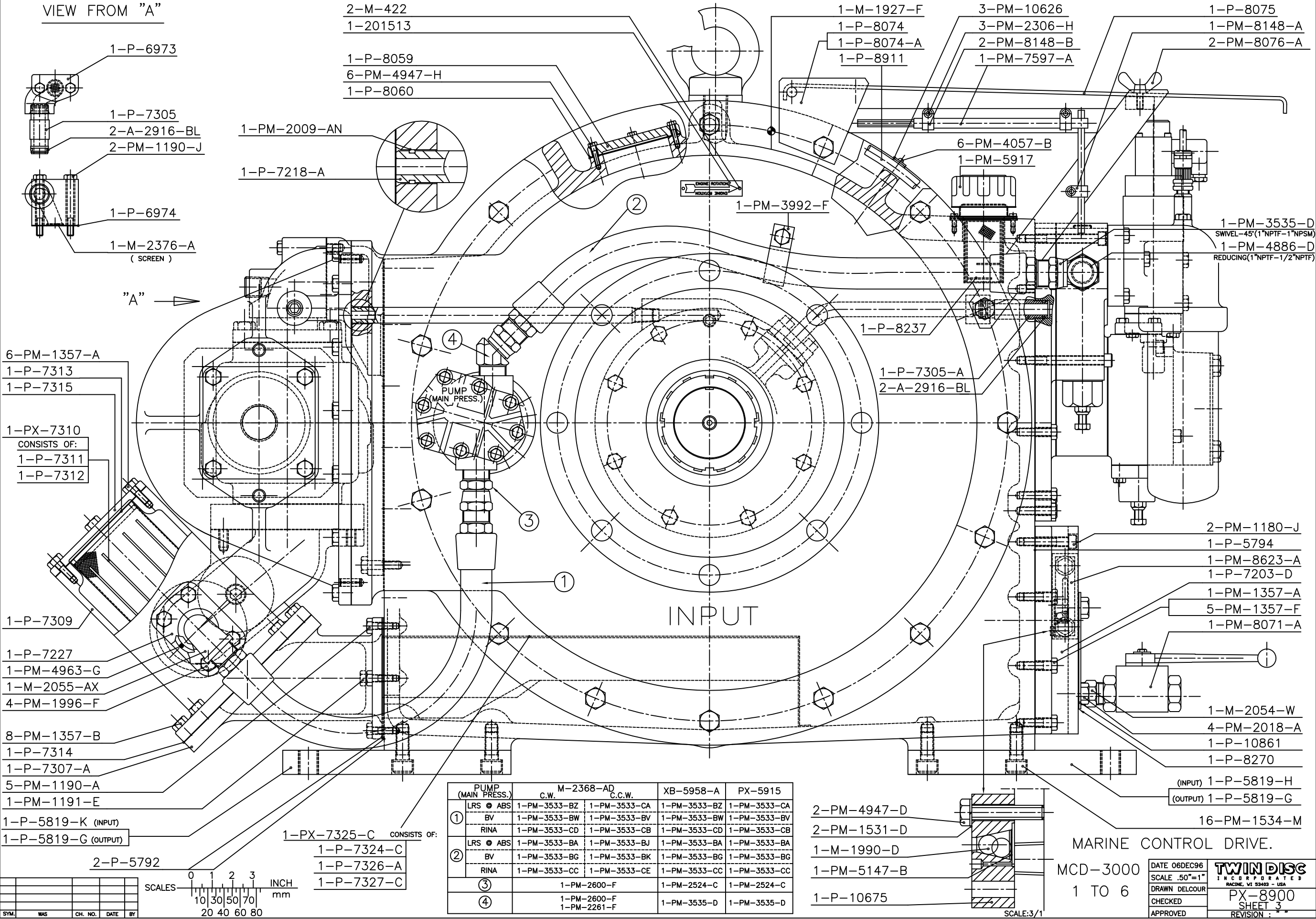


MCD-3000-1 TO 6
 MARINE CONTROL DRIVE.



DATE 06DEC96	TWIN DISC
SCALE .50"=1"	INCORPORATED
DRAWN DELCOUR	RACINE, WI 53403 - USA
CHECKED	PX-8900
APPROVED	SHEET 2
	REVISION : " "

VIEW FROM "A"



"A" →

ENGINE ROTATION
HOLLYWOOD ENGINE

INPUT

PUMP (MAIN PRESS.)		M-2368-AD		XB-5958-A	PX-5915
		C.W.	C.C.W.		
①	LRS ● ABS	1-PM-3533-BZ	1-PM-3533-CA	1-PM-3533-BZ	1-PM-3533-CA
	BV	1-PM-3533-BW	1-PM-3533-BV	1-PM-3533-BW	1-PM-3533-BV
	RINA	1-PM-3533-CD	1-PM-3533-CB	1-PM-3533-CD	1-PM-3533-CB
②	LRS ● ABS	1-PM-3533-BA	1-PM-3533-BJ	1-PM-3533-BA	1-PM-3533-BA
	BV	1-PM-3533-BG	1-PM-3533-BK	1-PM-3533-BG	1-PM-3533-BG
	RINA	1-PM-3533-CC	1-PM-3533-CE	1-PM-3533-CC	1-PM-3533-CC
③		1-PM-2600-F		1-PM-2524-C	1-PM-2524-C
④		1-PM-2600-F		1-PM-3535-D	1-PM-3535-D
		1-PM-2261-F			

6-PM-1357-A
1-P-7313
1-P-7315

1-PX-7310
CONSISTS OF:
1-P-7311
1-P-7312

1-P-7309
1-P-7227
1-PM-4963-G
1-M-2055-AX
4-PM-1996-F

8-PM-1357-B
1-P-7314
1-P-7307-A
5-PM-1190-A
1-PM-1191-E

1-P-5819-K (INPUT)
1-P-5819-G (OUTPUT)

2-P-5792

1-PM-2009-AN
1-P-7218-A

2-M-422
1-201513
1-P-8059
6-PM-4947-H
1-P-8060

1-M-1927-F
1-P-8074
1-P-8074-A
1-P-8911

3-PM-10626
3-PM-2306-H
2-PM-8148-B
1-PM-7597-A

1-P-8075
1-PM-8148-A
2-PM-8076-A

1-PM-3535-D
SWIVEL-45°(1"NPTF-1"NPSM)
1-PM-4886-D
REDUCING(1"NPTF-1/2"NPTF)

2-PM-1180-J
1-P-5794
1-PM-8623-A
1-P-7203-D
1-PM-1357-A
5-PM-1357-F
1-PM-8071-A

1-M-2054-W
4-PM-2018-A
1-P-10861
1-P-8270

(INPUT) 1-P-5819-H
(OUTPUT) 1-P-5819-G

16-PM-1534-M

MARINE CONTROL DRIVE.

MCD-3000

1 TO 6

DATE 06DEC96	TWIN DISC
SCALE .50"=1"	INCORPORATED
DRAWN DELCOUR	RACINE, VT 55403 - USA
CHECKED	PX-8900
APPROVED	SHEET 3
	REVISION : " "

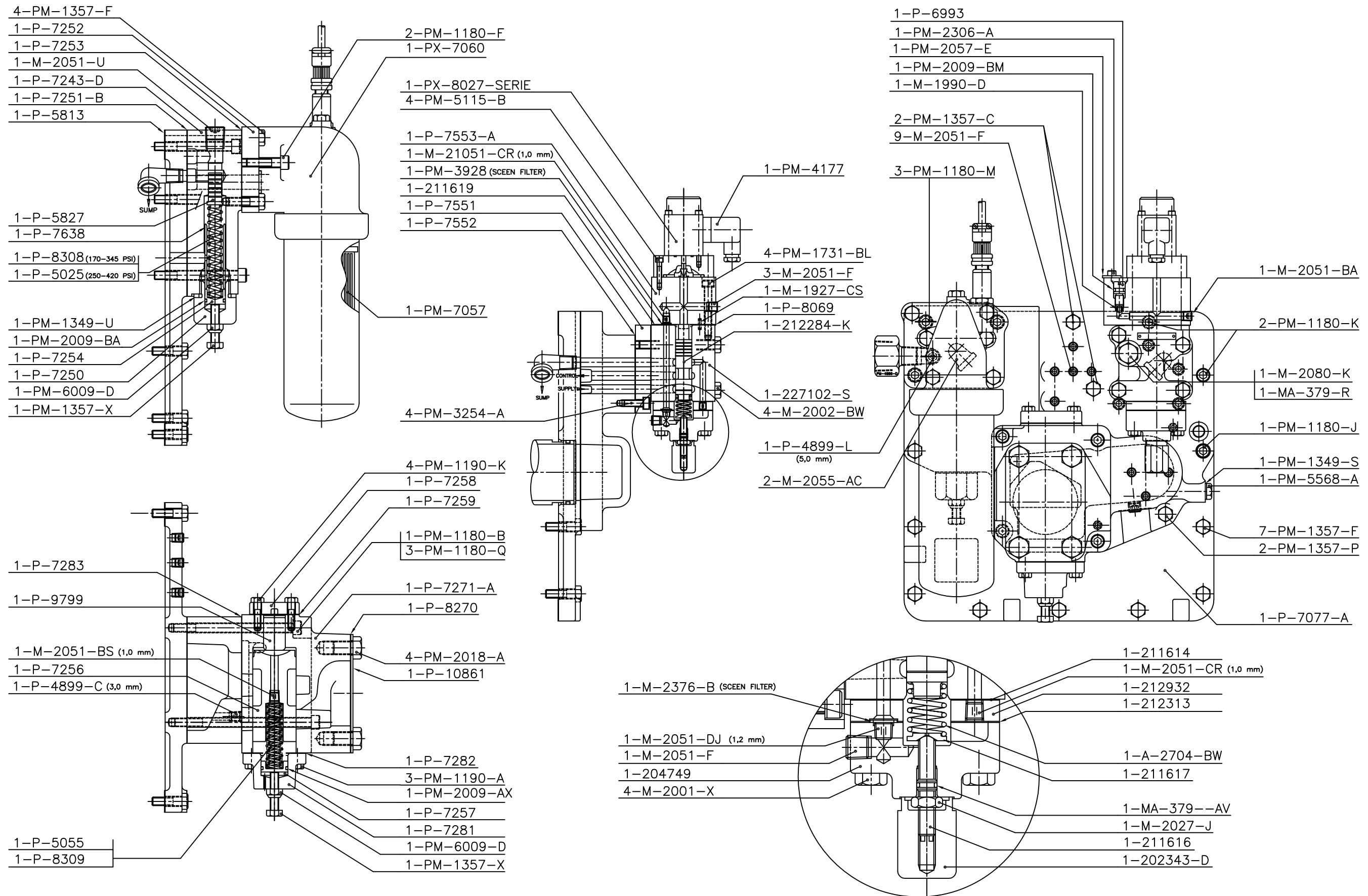
SYM.	WAS	CH. NO.	DATE	BY

SCALES 0 1 2 3 INCH
10 30 50 70 mm
20 40 60 80

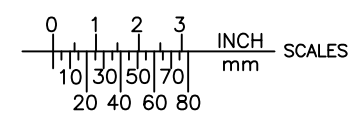
1-PX-7325-C CONSISTS OF:
1-P-7324-C
1-P-7326-A
1-P-7327-C

2-PM-4947-D
2-PM-1531-D
1-M-1990-D
1-PM-5147-B
1-P-10675

SCALE:3/1



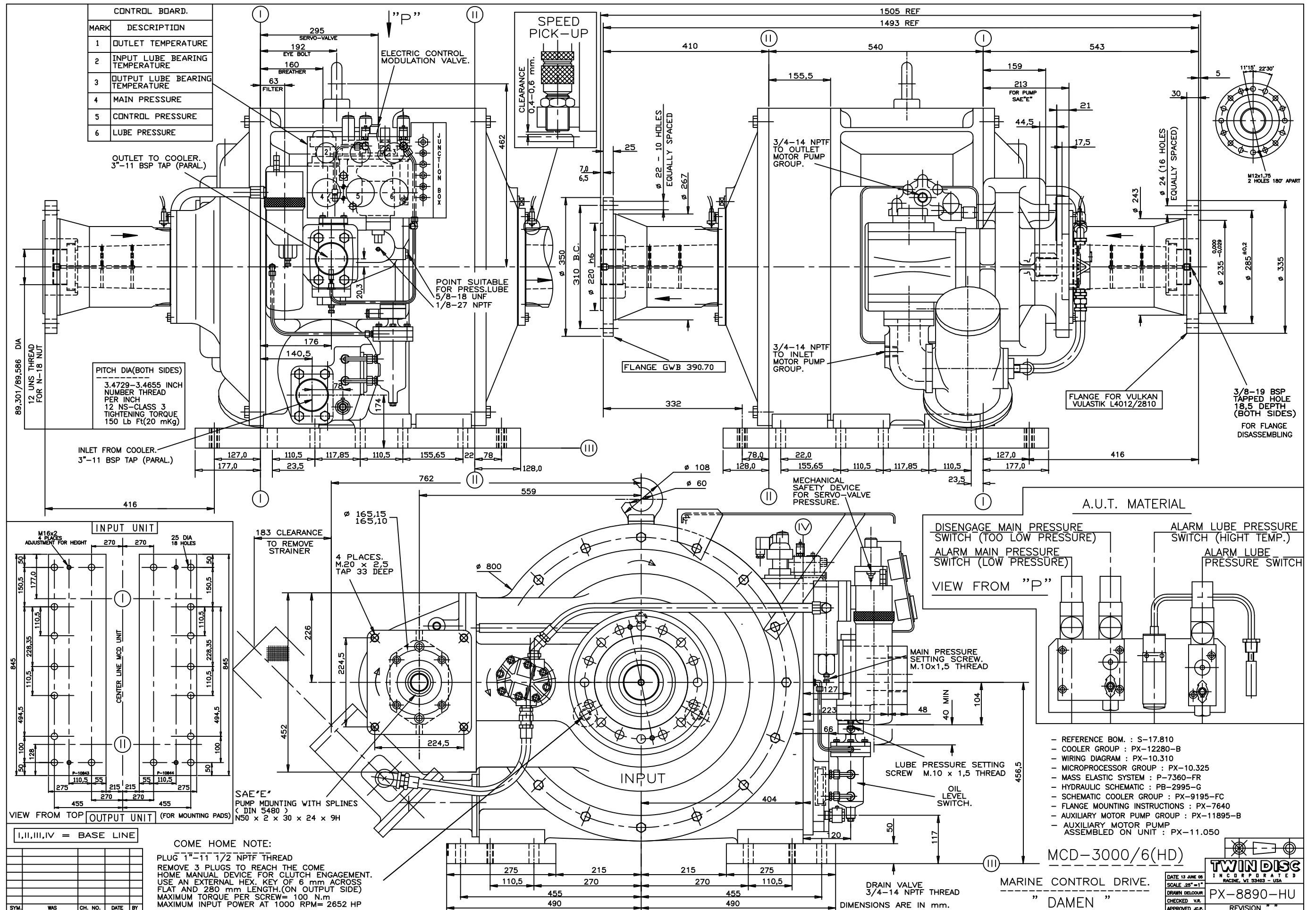
MARINE CONTROL DRIVE.
MCD-3000-1 TO 6

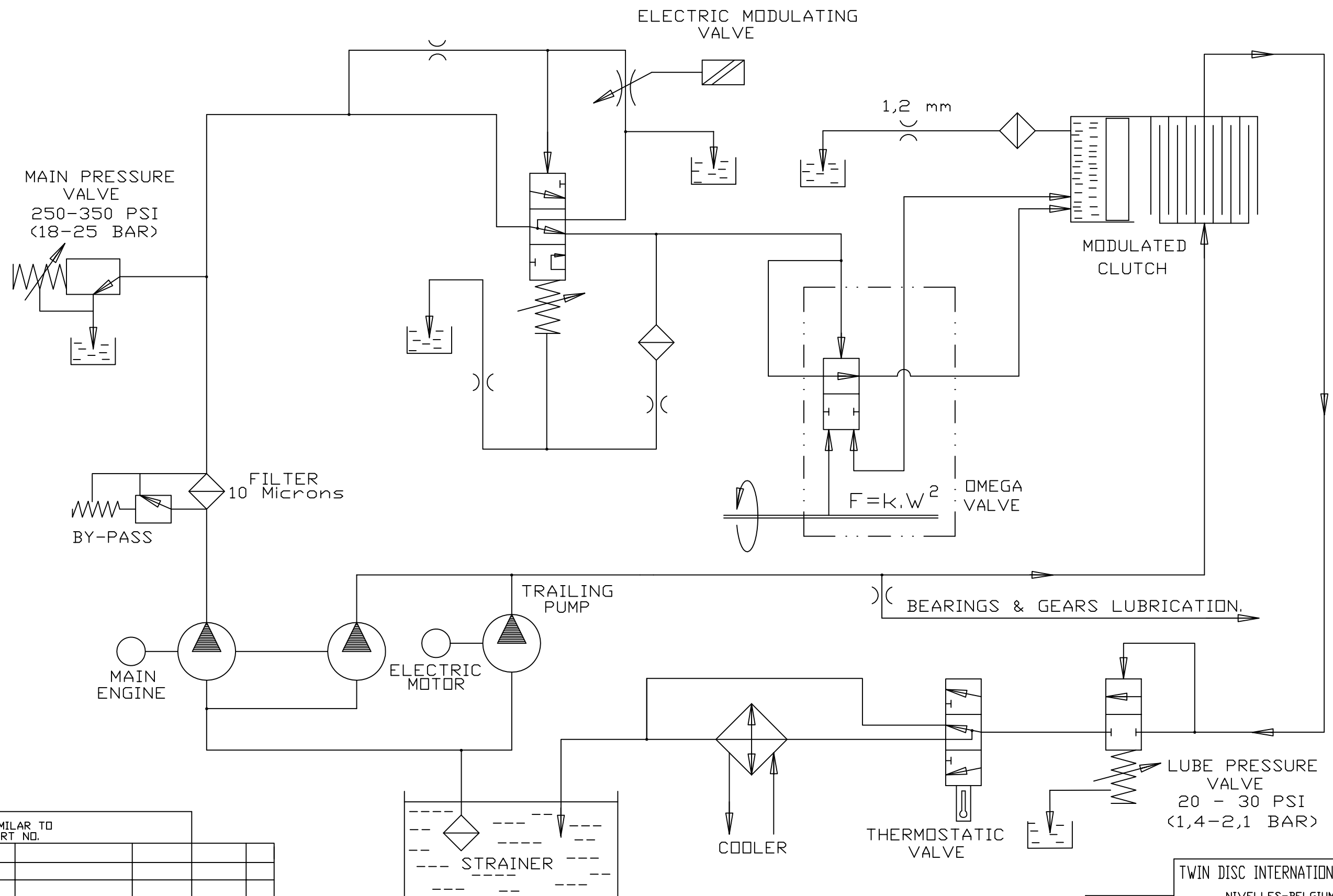


SYM.	WAS	CH. NO.	DATE	BY	SYM.	WAS	CH. NO.	DATE	BY

DATE 06JAN97	TWIN DISC INCORPORATED RACINE, WI 53403 - USA PX-8900 SHEET 4 REVISION : " "
SCALE .50"=1"	
DRAWN DELCOUR	
CHECKED	
APPROVED	

CONTROL BOARD.	
MARK	DESCRIPTION
1	OUTLET TEMPERATURE
2	INPUT LUBE BEARING TEMPERATURE
3	OUTPUT LUBE BEARING TEMPERATURE
4	MAIN PRESSURE
5	CONTROL PRESSURE
6	LUBE PRESSURE





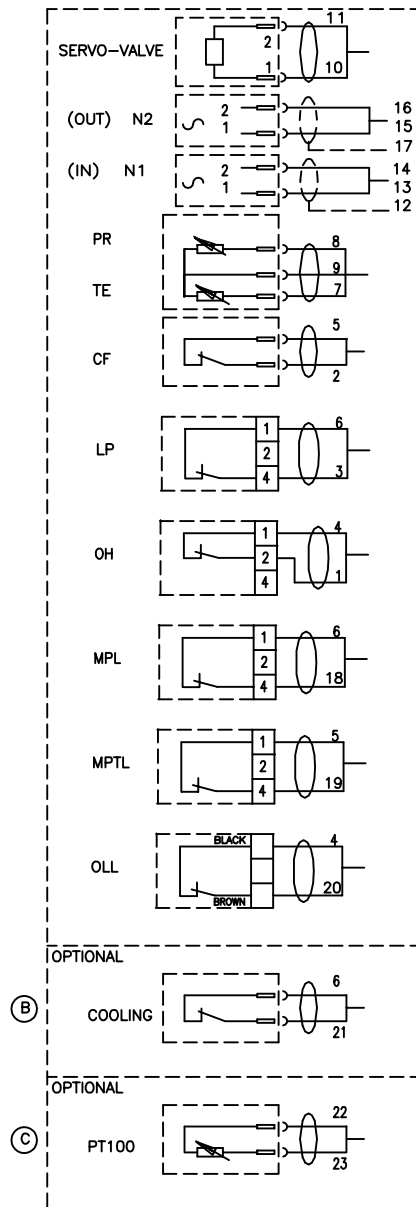
SIMILAR TO PART NO.				
A	REMOVED "PRIORITY VALVE"	4969	04/05/92	JD
SYM.	WAS	CH.NO	DATE	BY

MCD-1000 & MCD-3000

HYDRAULIC DIAGRAM

DATE 07MAY91	TWIN DISC INTERNATIONAL S.A. NIVELLES-BELGIUM RCNIVELLES 27008 TVA400-358-293 PB-2995-G
SCALE / =1"	
DRAWN DELCOUR	
CHECKED	
APPROVED	

M.C.D.



SYMBOLS

- N1: ENGINE SPEED
N2: MCD OUTPUT SPEED
PR: CONTROL PRESSURE GAUGE
TE: OIL TEMPERATURE GAUGE
CF: CLOGGED FILTER SWITCH
LP: LUBE PRESSURE SWITCH
OH: OVERHEATING SWITCH
MPL: MAIN PRESSURE LOW SWITCH
MPTL: MAIN PRESSURE TOO LOW SWITCH
OLL: OIL LEVEL LOW SWITCH
PT100: OIL TEMPERATURE GAUGE



SCREW TERMINAL, XX&YY ARE TERMINAL NUMBERS

A TO I:

CABLE NAME, REFER TO CABLE SPECIFICATIONS TABLE



SUPPLE CABLE HARNESS



SUPPLE CABLE WITH SCREEN HARNESS



DENOTES NO CONNECTION



ELECTRICAL JUNCTION



PUSH BUTTON: ON-OFF



PUSH BUTTON: ON-ON (WITH LOCKING)

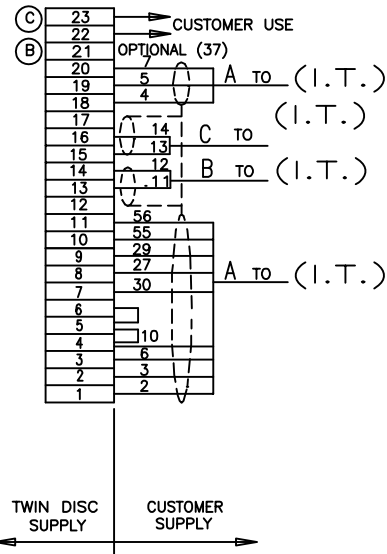


FRAME

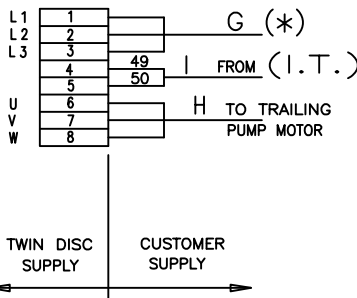


RELAY CONTACT (SEE RATING)

JUNCTION BOX (J.B.)



TRAILING PUMP (T.P.)

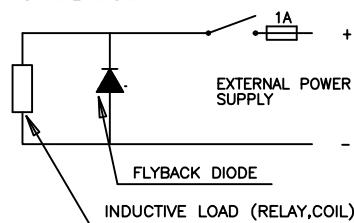


NOTE A:

CONTACTS RATINGS: 1A-24V.D.C.

TO PREVENT CONTACT FROM ARCING WHEN USED IN D.C. CIRCUIT CONNECT THEM AS FOLLOW:

EACH CONTACT IS PROTECTED WITH A 1A FUSE LOCATED AT THE REAR OF THE RACK.

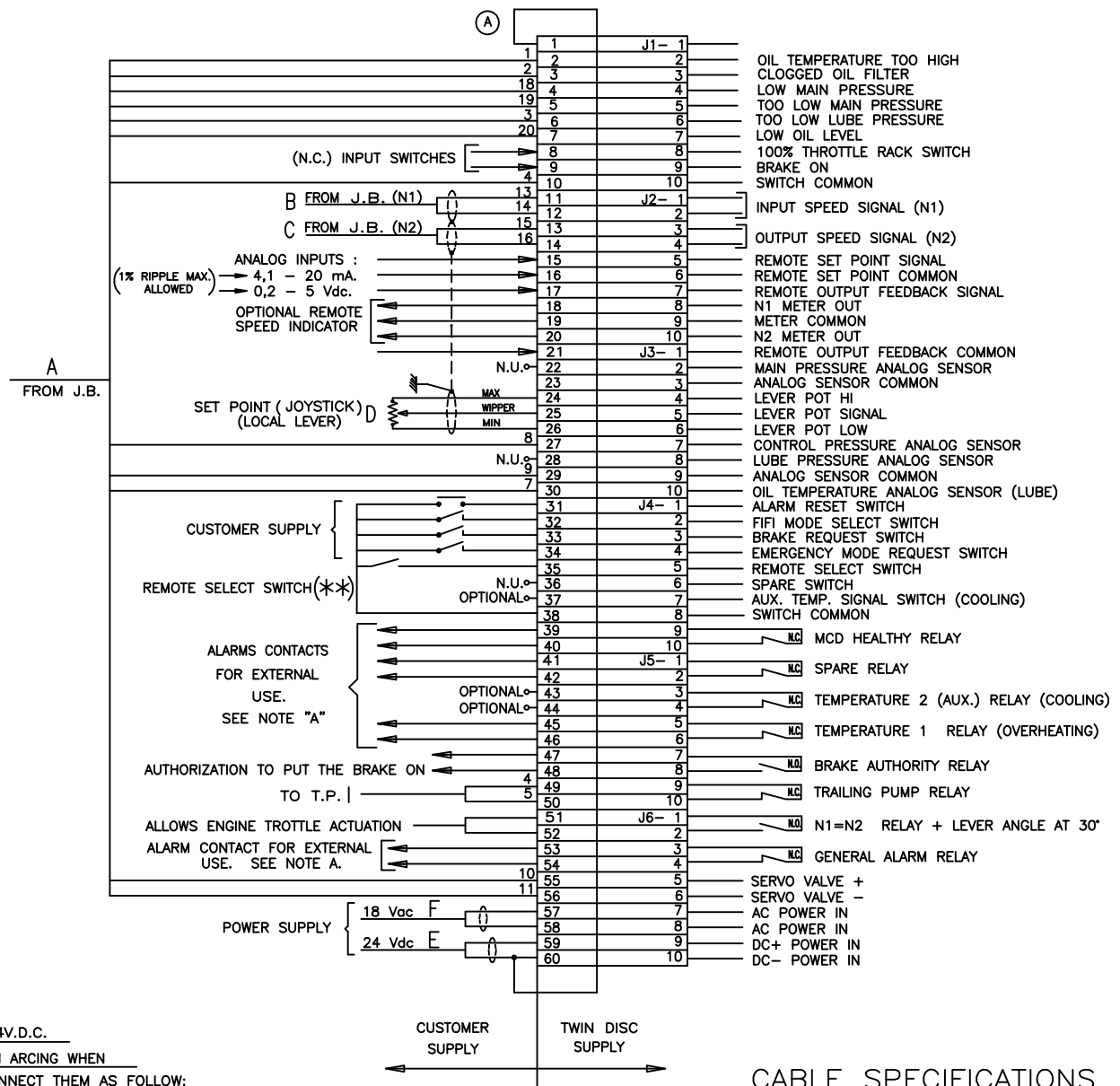


NOTE B:

THE NUMBER DRAWN ON EACH WIRE ARE TERMINAL NUMBERS FROM/TO WHICH THE WIRE MUST BE CONNECTED.

i.e. TERMINAL 3 OF JUNCTION BOX MUST BE CONNECTED TO TERMINAL 6 OF I.T. VIA CABLE "A". ON THE OTHER CABLE END TERMINAL 5 OF I.T. MUST BE CONNECTED TO TERMINAL 19 OF J.B.

INTERMEDIATE TERMINAL (I.T.)



CABLE SPECIFICATIONS

CABLE	DESIGNATION	O.D. MAX	SECTION NOM.
A	SCREENED CABLE	20 mm	12 x 0,75 ²
B,C	SCREENED CABLE	12 mm	2 x 0,75 ²
D	SCREENED CABLE		3 x 1,5 ²
E	SUPPLE CABLE		2 x 1,5 ²
F	SUPPLE CABLE		2 x 1,5 ²
G,H	SUPPLE CABLE	12 mm	3 x 1,5 ²
I	SUPPLE CABLE	8 mm	2 x 0,75 ²

(*)

REF. PX-8225-A	220/380 V - 50/60 Hz
REF. PX-8225-B	440 V - 60 Hz
REF. PX-8225-C	380 V - 50 Hz
REF. PX-8225-D	415 V - 50 Hz
REF. PX-8225-E	575 V - 60 Hz
REF. PX-8225-H	110 V - 60 Hz

(**)

WHEN USING THE LOCAL LEVER (JOYSTICK), THE SWITCH MUST BE OPEN.
WHEN USING THE REMOTE LEVER, THE SWITCH MUST BE CLOSED.

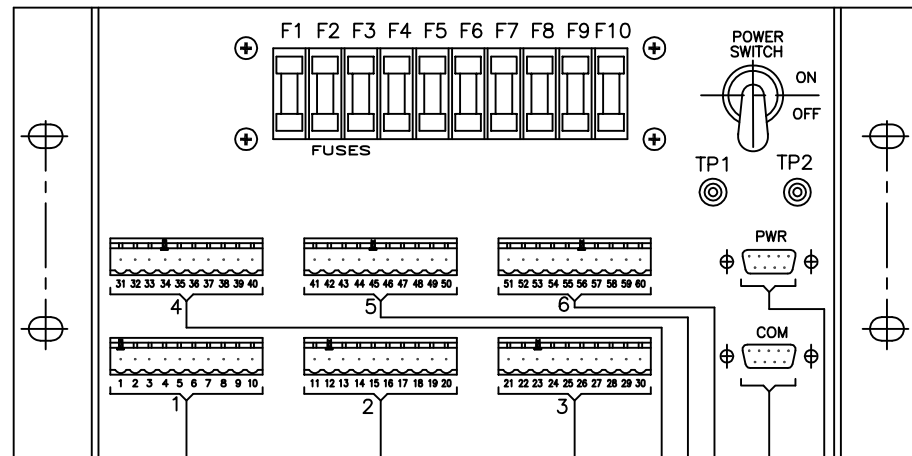
WIRING DIAGRAM

MCD.

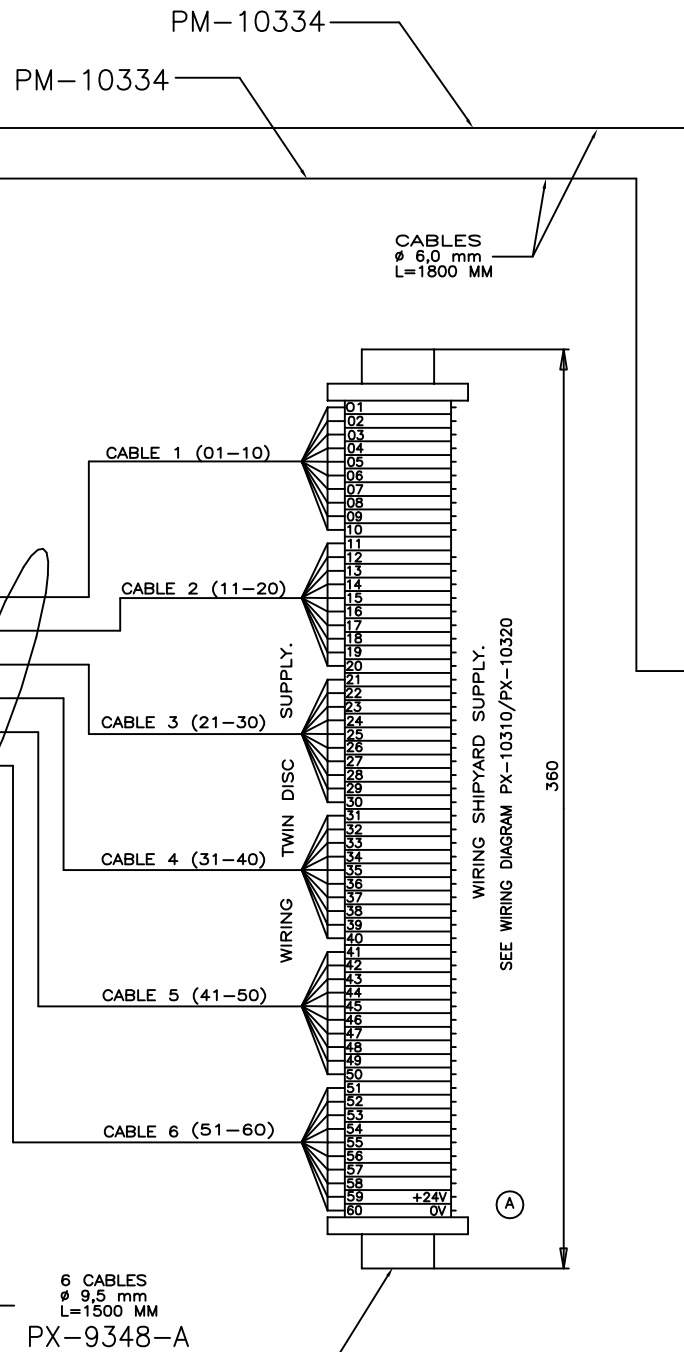
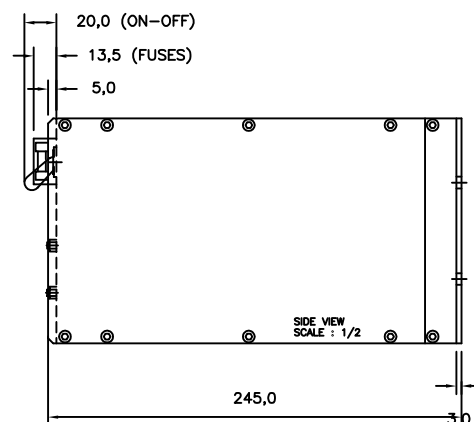
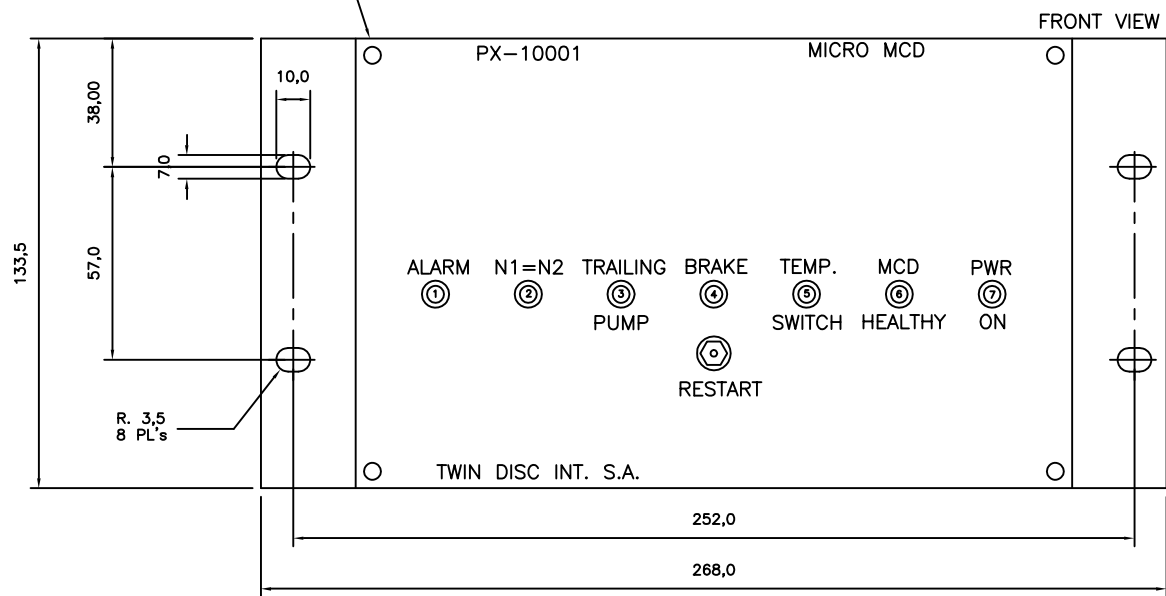
SYM	WAS	CH. NO.	DATE	BY	SYM	WAS	CH. NO.	DATE	BY
C	ADDED "PT100"	7231	27FEB04	J.D.					
B	ADDED "COOLING"	7101	27FEB04	J.D.					
A	GROUND REVISION (DNC)	5587	19OCT98	J.D.					

DATE 07 AUG. 95	TWIN DISC INTERNATIONAL S.A. NIVELLES-BELGIUM RUE NIVELLES 27008 TEL. 02-388-283
SCALE - 1"	PX-10310
DRAWN DELCOUR	CHECKED R.V.
APPROVED J.C.P.	CHANGE 70"

- 1 LED RED
- 2 LED GREEN
- 3 LED YELLOW
- 4 LED YELLOW
- 5 LED RED
- 6 LED GREEN
- 7 LED GREEN
- 8 LED GREEN
- 9 LED YELLOW
- 10 LED RED
- 11 LED YELLOW

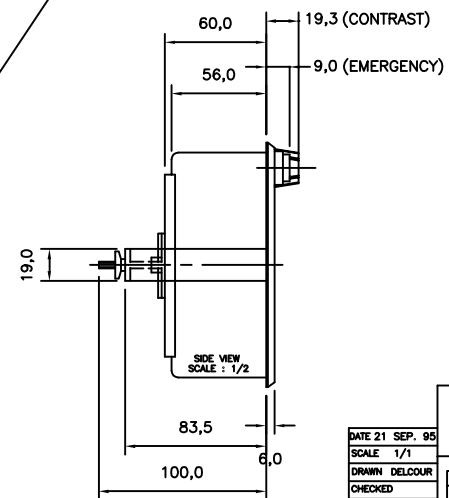
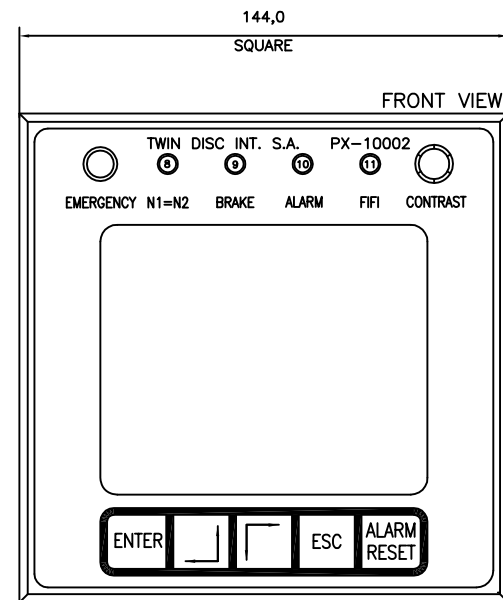
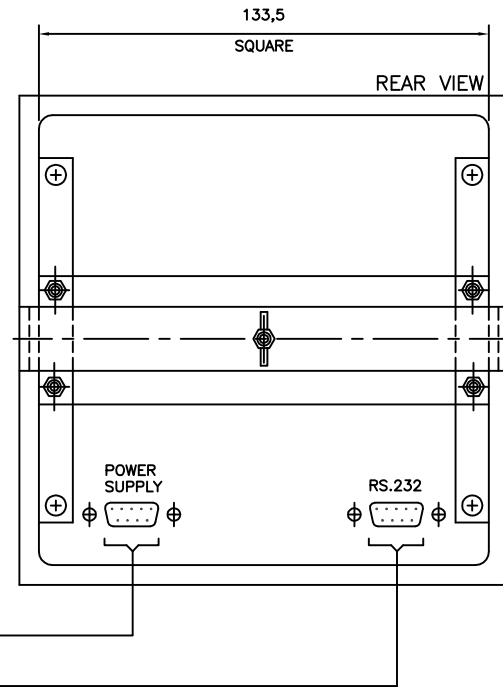


PX-10001
CUTTING HOLE DIMENSIONS
134 mm x 233 mm.



INTERMEDIATE TERMINAL

PX-10002
CUTTING HOLE DIMENSIONS
134 mm x 134 mm.



UCD-MCD CONTROLLER INSTALLATION

SYM	REV	WAS	CH. NO.	DATE	BY
A	1	WAS	5587	19OCT96	J.D.

METRIC

TWIN DISC
INCORPORATED
RACINE, WI 53403 - USA

DATE 21 SEP. 95
SCALE 1/1
DRAWN DELCOUR
CHECKED
APPROVED

PX-10325

The diagram illustrates a 3-phase power distribution system. It begins with three input lines labeled L1, L2, and L3. These lines pass through a main switch Q1, which is equipped with fuses F2, F3, and F4. The lines then pass through a circuit breaker KM and a fuse block F1. The system includes a 4 AMP. fuse, a transformer TR (24 V, 50 Hz/60 Hz), and a 0,55 KW motor M with voltage U, V, and W terminals.

SIMILAR TO
PART NO.

SYM.	WAS	CH.NO	DATE	BY

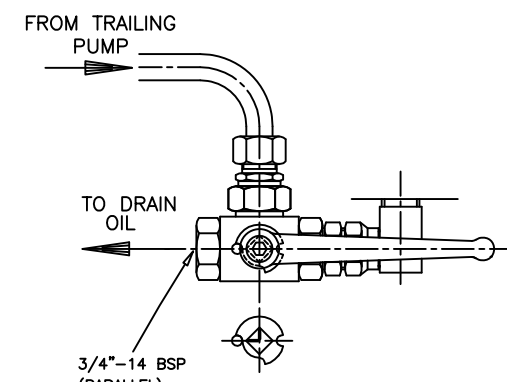
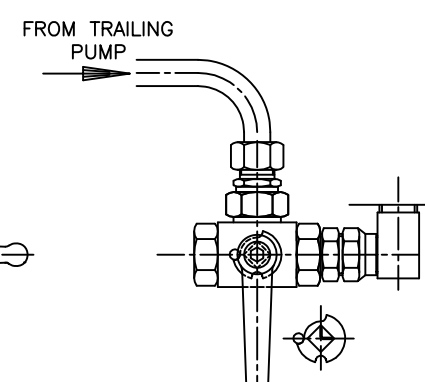
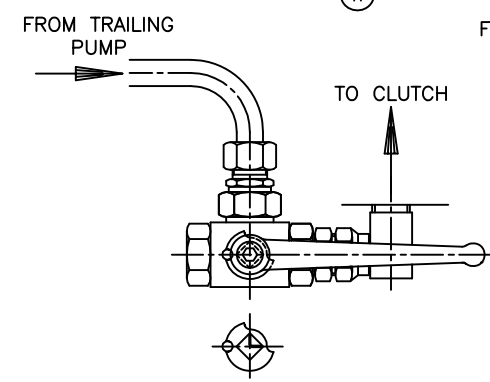
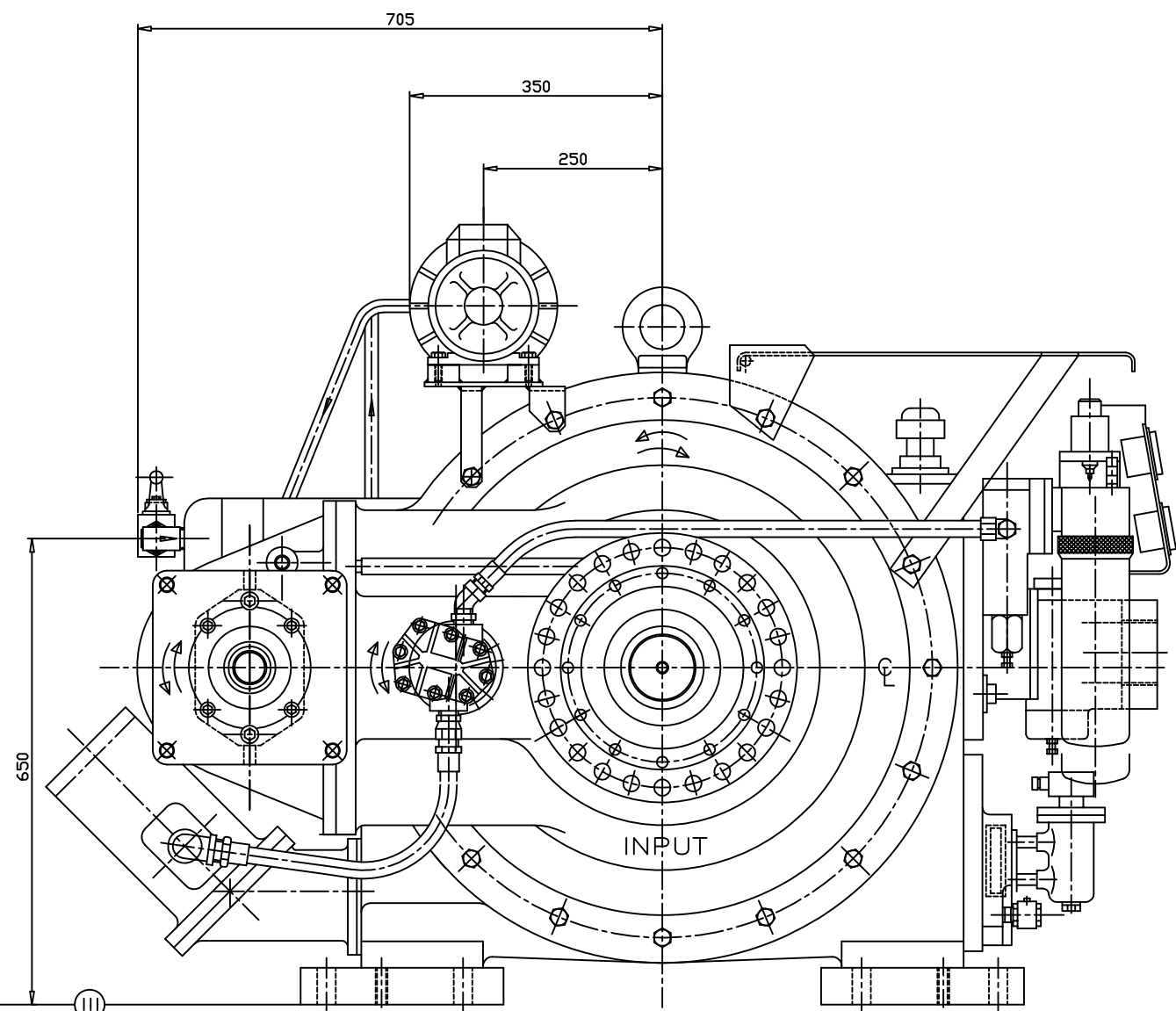
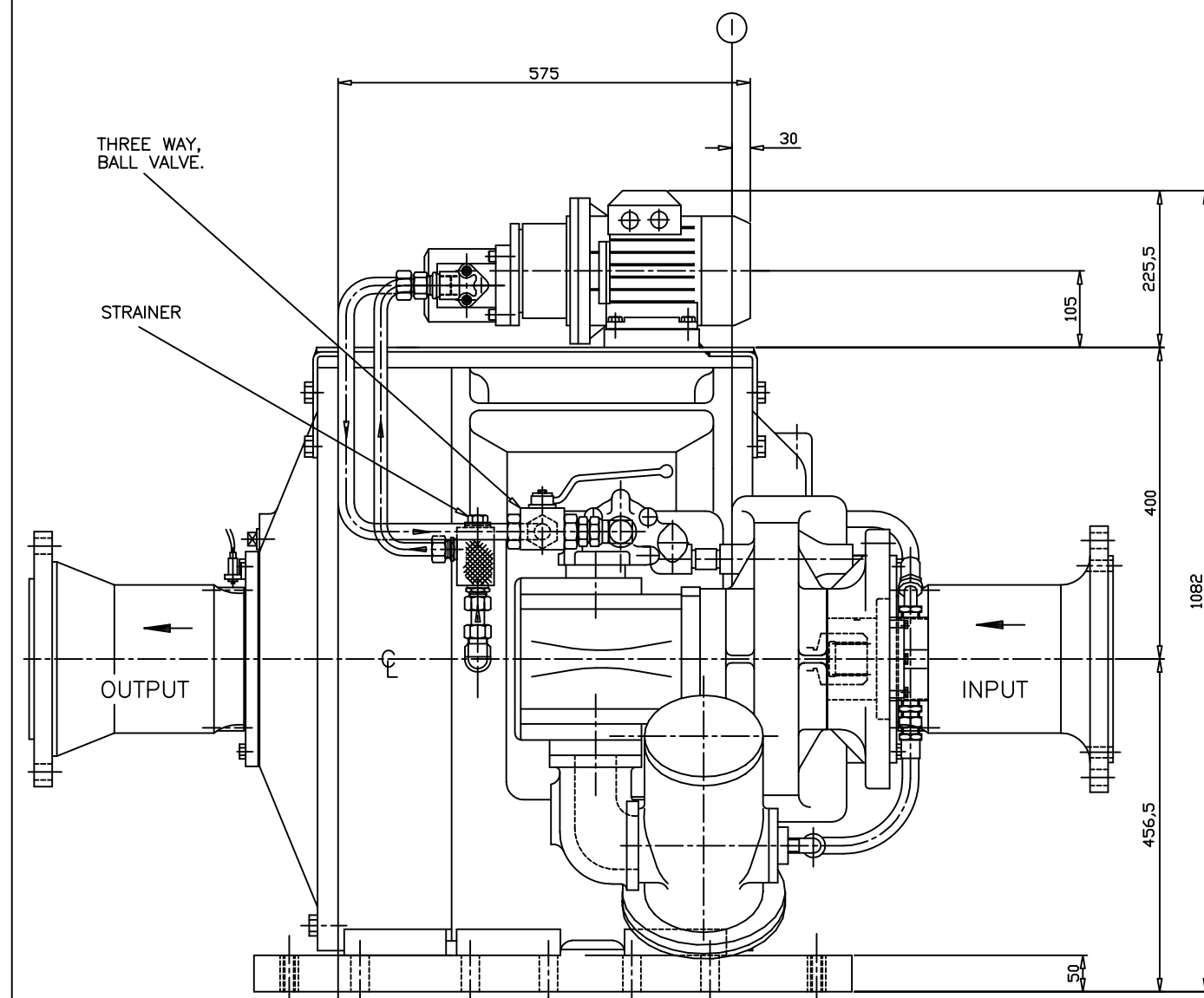
SYM.	WAS	CH.NO	DATE	BY

SURFACE TRAITEMENT		ASSEMBLY No.	FIRST USE MODEL No.	MCD	DATE 20/09/99
WEIGHT		ELECTRIC DIAGRAM			SCALE / =1"
ROUGH	FINISHED				DRAWN DELCOUR
					CHECKED R.V.
					APPROVED J.C.B.

TWIN DISC
INCORPORATED
RACINE, WI 53403 - USA

PX-8225-M

REVISION " "

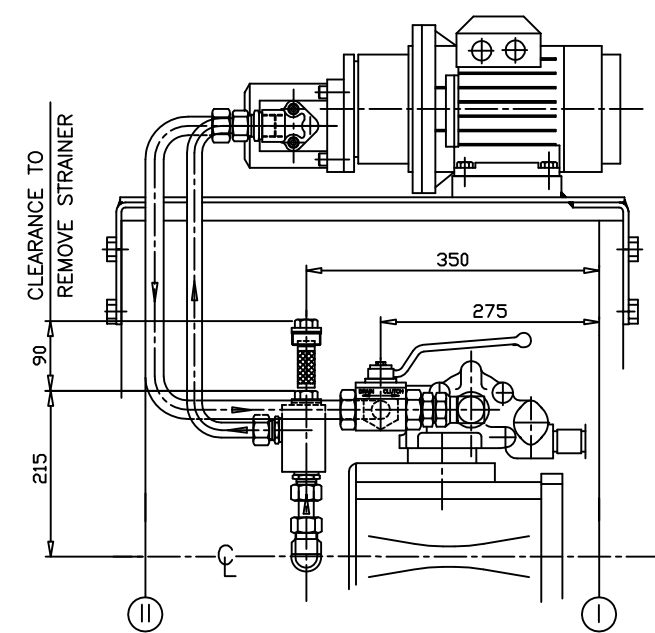


1) LOCKED POSITION FROM FACTORY, LUBE OIL TO CLUTCH IF TRAILING PUMP IS RUNNING.

2) PULL OUT THE LEVER AND LOCK WASHER, SET THE LOCK WASHER AS SHOWN (90° C.C.W.) AND SET THE LEVER BACK ON SQUARE.

3) TURN 90° C.C.W. THE LEVER TO DRAIN OIL FROM MCD UNIT.

THREE WAY, BALL VALVE



"AUXILIARY MOTOR PUMP GROUP"

ASSEMBLED ON UNIT"

MARINE CONTROL DRIVE.

SYM.	WAS	CH. NO.	DATE	BY

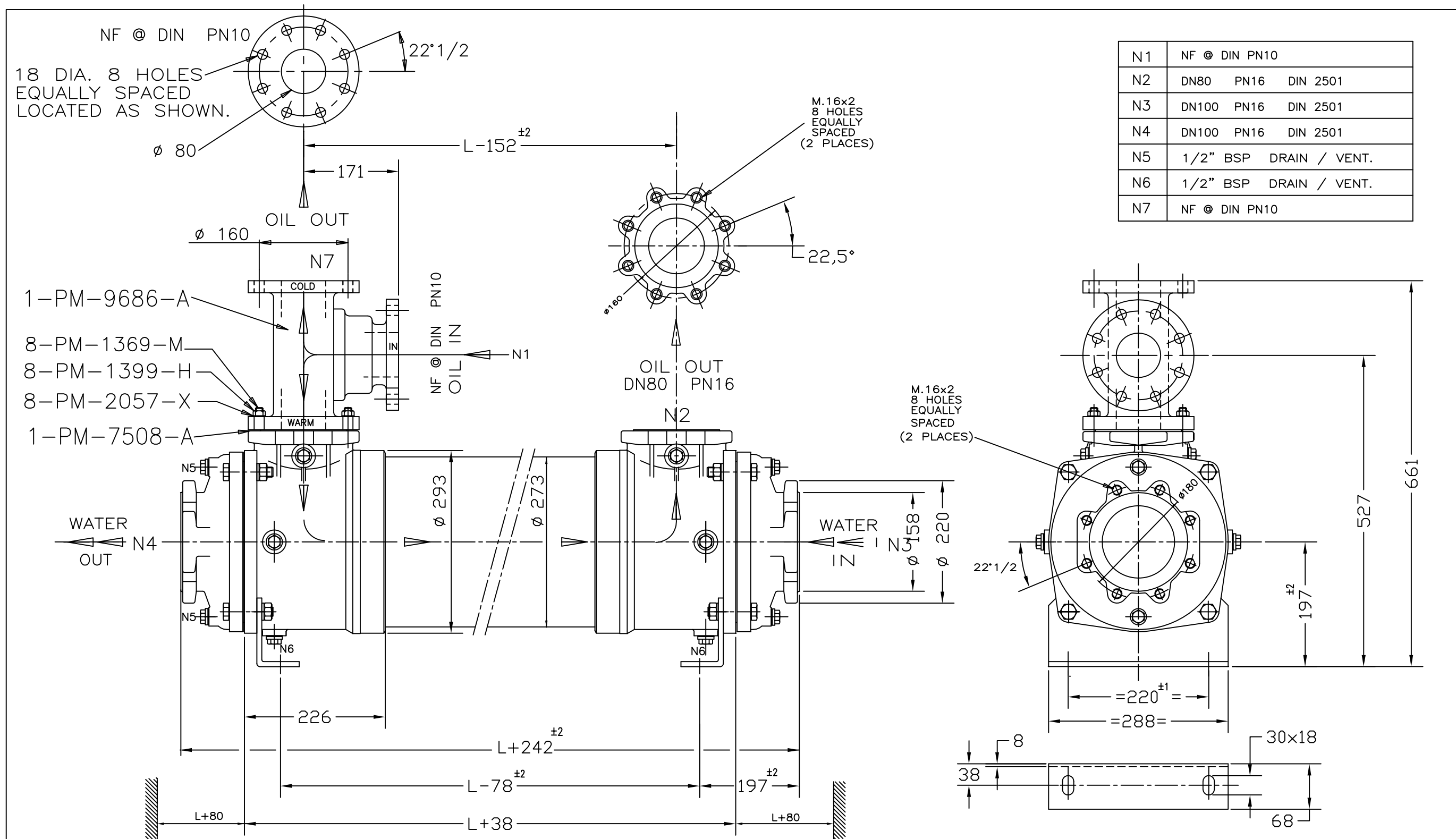
I,II,III = BASE LINE

TWIN DISC
INCORPORATED
RACINE, WI 53403 - USA

DATE 28 SEP. 89
SCALE 25" = 1"
DRAWN DELCOUR
CHECKED Y.A.
APPROVED M.P.

PX-11050

REVISION



ASSEMBLY NUMBER	PX-12280-A	PX-12280-B	PX-12280-C	PX-12280-D	PX-12280-E	PX-12280-F	PX-12280-G	PX-12280-H	PX-12280-J	PX-12280-K	PX-12280-L	PX-12280-M	PX-12280-N	PX-12280-P	PX-12280-Q
USE HEAT EXCHANGER	PM-12275-A L=2200	PM-12275-B L=2400	PM-12275-C L=1600	PM-12275-D L=2400											

DIMENSIONS ARE IN MM.

SYM.	WAS	CH.NO	DATE	BY

ASSEMBLY NUMBER	PX-12280-R	PX-12280-S	PX-12280-T	PX-12280-U	PX-12280-V	PX-12280-W	PX-12280-X	PX-12280-Y	PX-12280-Z
USE HEAT EXCHANGER									

COOLING ASSEMBLY

DATE 22 SEP.2004
SCALE / =1"
DRAWN DELCOUR
CHECKED R.V.
APPROVED JC.P.

TWIN DISC INCORPORATED RACINE, WI 53403 - USA
PX-12280 A TO Z
REVISION * *

HEAT EXCHANGER REQUIREMENTS.

MIN. AND MAX. OIL TEMPERATURE AT HEAT EXCHANGER INLET: (71°C–85°C)(160°F–185°F)

MAX. POWER TO HEAT : 282 KW.

OIL FLOW AT MAX. POWER TO HEAT POINT : 493 l/min.

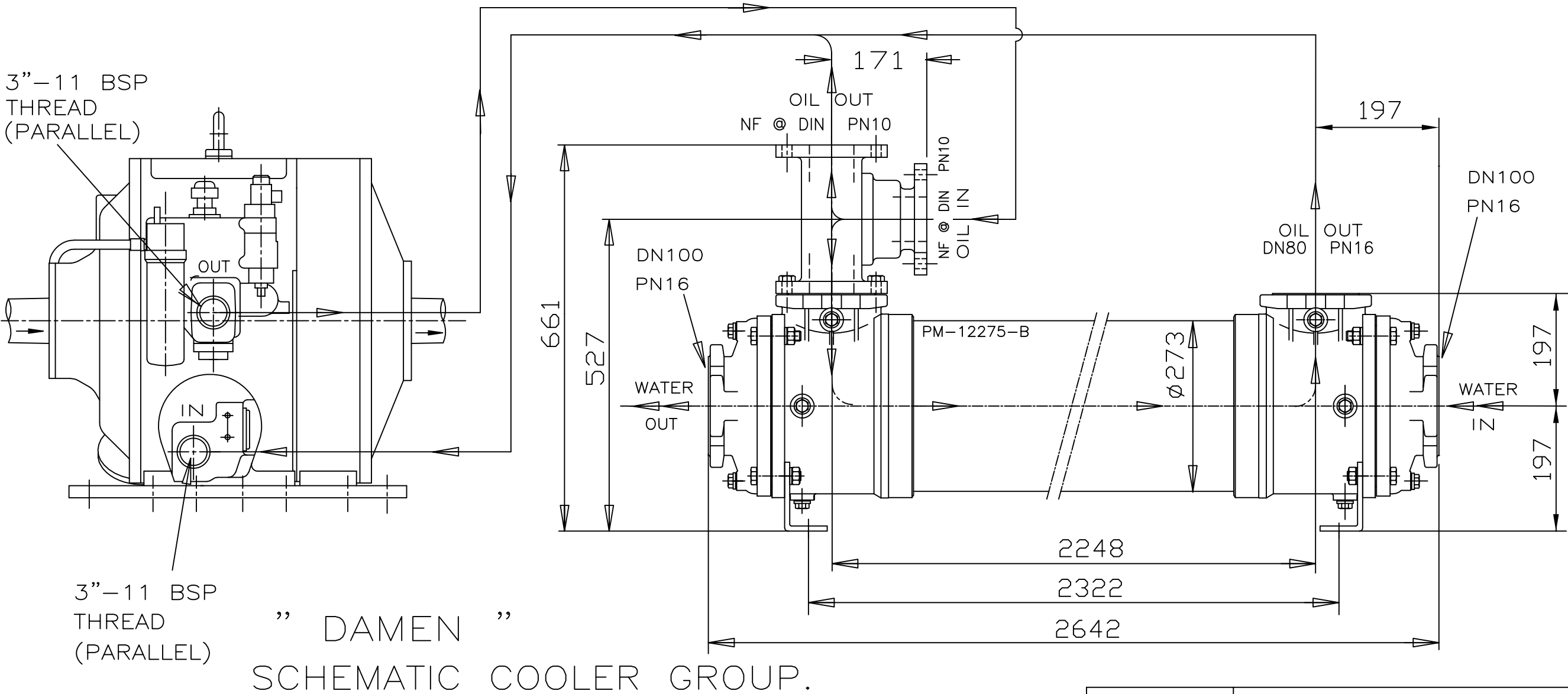
MAX. ALLOWABLE PRESSURE DROP 0,13 BAR ACROSS H.E. + HOSES.

MAX. PEAK OIL PRESSURE : 6 BAR **

**DEPENDING ON HOSE DIA. AND LENGTH (CUSTOMER SUPPLY) BETWEEN H.E. OUTLET AND SUMP.

WATER PRESSURE DROP : 0,05 BAR.

NECESSARY WATER FLOW AT 61,0 °C INLET : 30 m³/H (FRESH WATER)



					15 JUNE 05		PX-9195-FC
					DRAWN DELCOUR		
					CHECKED R.V.		
SYM	WAS	CH.NO	DATE	BY	APPR. JC.P.		
					MCD-3000-6(HD)		REVISION " "
					TWIN DISC INTERNATIONAL S.A.		
					NIVELLES-BELGIUM		
					R.C.NIVELLES 27008 TVA.400-358-293		

